

## AN EVALUATION OF MONETARY POLICY IN VIETNAM, 1998-2016

An SVAR approach

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<b>Objectives</b> The main objectives of this study were the dynamic relationships of various macroeconomic variables to explore how monetary policy affects output and especially inflation in Vietnam, and suggest some improvements for monetary policy in Vietnam.
<b>Summary</b> In 1998-2006, the main contributors of variation are GDP itself and rice shocks but are only GDP shocks in 2007-2016. Main drivers of inflation during 1998-2006 are its own innovations and shocks from external factors. Nevertheless, in the following period, they are its own shocks and shocks from oil price and domestic credit aggregate. Credit channel is found to have an important role in monetary transmission mechanism, while interest rate might not be the main instrument of the central bank to control inflation
<b>Conclusions</b> The empirical results and economic conditions in Vietnam suggest that the central bank should try to improve the channels for monetary transmission with the focus on the interest rate channel. Moreover, it should take into consideration the movements of foreign variables and implement the appropriate policy to counter the effects of these variables.
<b>Key words:</b> <i>monetary policy, inflation, SVAR, Vietnam, economic growth</i> See: <a href="http://web.lib.aalto.fi/en/helevoc/pdf/">http://web.lib.aalto.fi/en/helevoc/pdf/</a>
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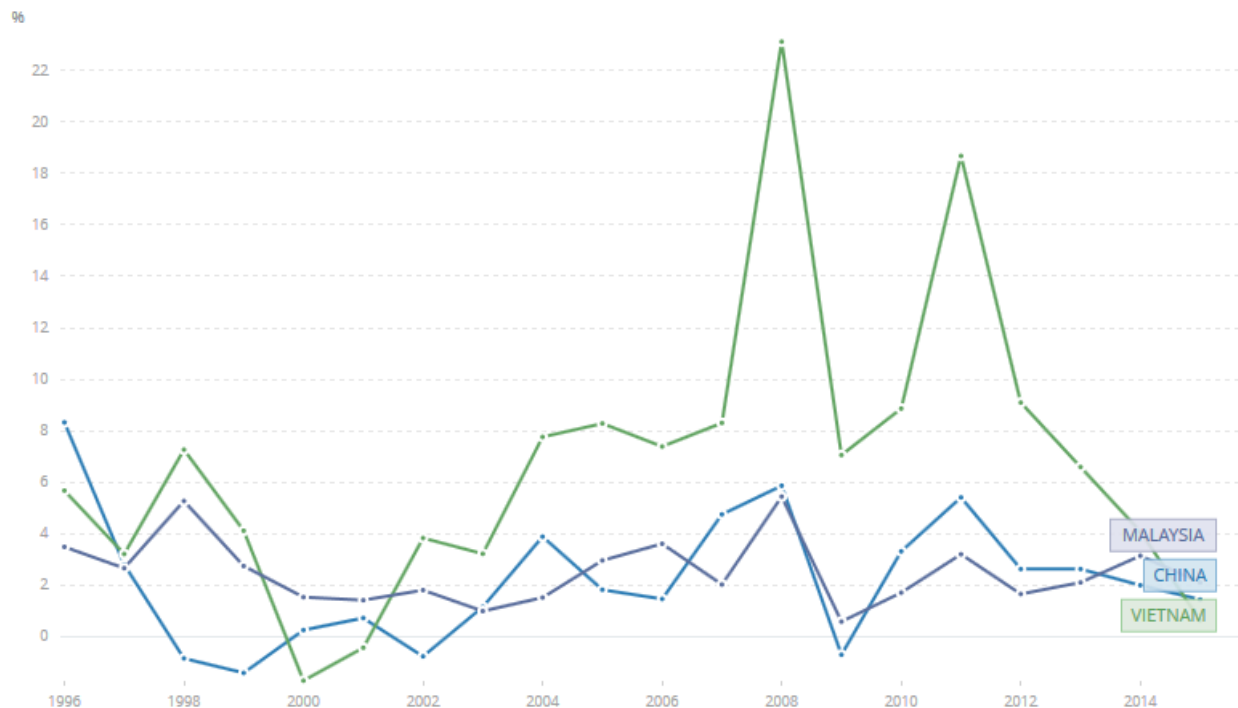
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# 1. INTRODUCTION

## 1.1. Introduction and research problems

For the last 20 years, Vietnam has enjoyed a good economic growth with the average annual rate of more than 6%. However, the economy also experienced comparatively higher inflation than other emerging economy in the same geographical area as shown in the figure below:

*Figure 1: Inflation of some emerging economies in Asia, 1996-2014*



Source: World Bank (2017).

Moreover, inflation in Vietnam is extremely high in 2008 and 2011, and although inflation has decreased to normal level in the recent years, policymakers still need to examine this phenomenon to avoid a similar scenario happen in the future.

This paper focuses on monetary policy in Vietnam, and studies the dynamic relationships of various macroeconomic variables to explore how monetary policy affects output and

especially inflation in Vietnam, and suggest some improvements for monetary policy in Vietnam.

## **1.2. Research questions**

More specifically, this study aims to answer these questions:

- How do macroeconomic variables affect output and inflation in Vietnam?
- How significantly do domestic and foreign variables affect output and inflation in Vietnam?
- What are the main drivers of output growth and inflation in the short-term?
- What are the implications for monetary policy in Vietnam?

## **2. VIETNAMESE ECONOMY AND MONETARY POLICY**

### **2.1. An overview of Vietnamese economy**

The economy of Vietnam can be divided into three sub-periods after its unification in 1975, namely 1975-1986, 1986-2007, and 2007-now.

#### **2.1.1. 1975-1986**

From 1975 to 1986, Vietnamese economy is a closed and centralized economy controlled entirely by the government (Cima, 1987). This period is characterized by economic stagnation with shortages due to inefficiency in distribution and reduction in production, high and rising inflation as well as a reduction in foreign aid. Especially, the aid from other communist countries decreased significantly due to the termination of Vietnam War (Cima, 1987 and Vo et al, 2002). Furthermore, state-owned enterprises (SOEs) were the only component of the economy during this period (Pham, 2016).

#### **2.1.2. 1986-2007**

In 1986, the government implemented a reform campaign called 'Doi Moi' to transform the economy from centralized to market-oriented and open for international collaborations. SOEs obtained a larger autonomy and still operated as the main structure of the economy.

In the following years, several policies and innovations were introduced with the focus on food, goods, domestic trade and exports. Fundamental markets of the economy, namely the markets for money, labor, good, and land were gradually established. In this period, the availability of banknotes increased significantly and resulted in a period of hyperinflation during 1986-1989, yet the annual GDP growth is relatively low- 3.9%.

From 1991-1996, because of the collapse of the Soviet Union and other communist countries in Eastern Europe, Vietnam lost a significant amount of foreign aids from these countries. The government had attempted to complete the transition to a market economy and achieved economic stability. The subsidies for SOEs was gradually abandoned. Economic policies in this period were evaluated as successful since the economy had experienced good GDP growth and rapid poverty reduction while inflation was effectively controlled for – inflation rate reduced from over 100% to less than 20% (General Statistics Office – GSO, 2017).



1997 was the year that the financial crisis happened, amplified, and spread from Thailand to other Asian countries. Despite the geographical proximity, Vietnam only experienced limited effects from the crisis as its economy remained relatively close. These negative effects are mainly a reduction in foreign direct investment (FDI) and a drop in annual GDP growth rate (General Statistics Office – GSO, 2017).

Since 2000, after experiencing slightly negative effects from the Asian financial crisis, the economy seemed to recover with a high and stable economic growth – circa 7% annually. There are structural changes in the economy as the contribution of industry sector increase to approximately a quarter, and several high value-added services came into existence in the service sector. There is also a significant increase in exports and imports in this period. Moreover, the role of the private sector seemed to be enhanced by the new enterprise law, but receive only limited investments from the government comparing to that of the state sector. According to Nguyen (2014), it is estimated that the productivity of the private sector is much higher than that of the state sector. However, SOEs remained to be inefficient yet dominated. In additions, from 2000 to 2001, deflation occurred, and in 2002-2007, inflation picked up and increased to 8% in 2007.

#### **2.1.3. 2007-now**

With Vietnam's WTO accession in 2007, the economy of Vietnam become more open and integrated into the global economy. FDI, exports, and imports enormously increase after 2006. However, the 2008 financial crisis exerted a severe impact on Vietnamese economy. Due to a decrease in export, the country suffered from significant trade deficit comparing to that of the previous period. A large amount of foreign capital outflows created a crash on stock markets with a 50% drop in the index. Many firms in the private sector struggled or went bankrupt due to rising borrowing costs. The state sector, facing low domestic demand and a fall in exports, had accumulated a considerable amount of debts. Overall, the economy experienced a low growth rate of 5-6% and high inflation from 2008-2012 with the peaks of 23.16% in 2008 and 18.67% in 2011.

#### **2.1.4. Dollarization in the economy**

At the beginning of the 1990s, when the economy experienced hyperinflation, dollarization start to exist in the economy. The substantive loss in value of the domestic

currency due to hyperinflation drove the citizens to keep USD as an attempt to protect their property. After this period, the problem of dollarization rises again in periods with high inflation such as 2007-2011 and weakens in periods with low inflation, namely 1995-2002. The existence of dollarization in the economy can be seen in real estate sector when the price is set in USD or gold. Moreover, movements in gold price and USD value are almost instantaneous translated into fluctuations in the price of real estate and contribute significantly to the variation of inflation (Nguyen and Nguyen, 2010). Furthermore, in a study by Nguyen (2012), dollarization is estimated to remain at 30%.

## **2.2. Monetary policy in Vietnam**

### **2.2.1. The State Bank of Vietnam (SBV)**

In general, the SBV only has limited power in designing and conducting monetary policy in Vietnam.

As stated by Vietnam National Assembly, SBV is responsible for preparing reports of previous monetary policy operation and economic outlook annually, and submitting a proposal for monetary policy operation in the following year to the government. The government then revises and possibly adjusts the projection with the consultancy of National Monetary Policy Advisory Council. The final projection is sent to National Assembly for final approval (1997).

After receiving the final approval, SBV will implement the monetary policy under the supervision of the National Assembly and can make some minor adjustments to changes in financial markets.

### **2.2.2. The objectives of monetary policy in Vietnam**

The objectives of monetary policy in Vietnam are broad and without a clearly defined primary one. These includes stabilizing the value of the currency, promoting socio-economic development, maintaining national security, and improving living standards (Law on the State Bank of Vietnam, 1997). While other countries only focus on price stabilization or inflation target, with multiple objectives, the Vietnamese government has to choose ones over others among them, namely inflation and economic growth.

Many researchers suggest that economic policies in Vietnam indicate that economic growth is the primary goal of Vietnamese government (Pham, 2011, To et al., 2012 and Pham, 2016). However, as average inflation rate increased significantly from 3.4% in 1996-2000 to 11.4% in 2006-2010 while average GDP growth rate maintained in the range 7%-7.5% in the same period. According to IMF (2006), an inflation rate higher than 3.6% exerts a negative impact on growth. Therefore, despite an economic growth of over 7%, with the inflation rate of 11.4%, Vietnamese government seemed to fail to achieve the objective of economic growth (To et al., 2012).

### **2.2.3. Financial system in Vietnam**

#### *2.2.3.1. Banking sector*

Before 1988, SBV not only had the functions of a central bank but also operated as a commercial bank. In this period, the primary responsibilities of SBV are to support the implementation of government's policies and to help SOEs in financing their activities. In 1988, the government established first state-owned commercial banks (SOCBs), and SBV then was only a central bank. In 1991, joint-stock commercial banks (JSCBs) were founded. In 1992, foreign-owned banks were allowed to open their branches in Vietnam but had to follow strict regulations. For instance, their local capitalization must be USD 15 million at the minimum, and they could not lend more than 10% of the total capital in a single project. First 100% foreign-owned banks are licensed to operate in 2008.

The banking market is largely controlled by SOCBs as only five SOCBs make up more than half of total asset and credit in the market from 1997 to 2008 (SBV, 2017). SOCBs have an average chartered capital of approximately 16,000 billion VND (800 million USD) in 2010, which is mainly funded by the government. The major customers of SOCBs are SOEs (Quach, 2011).

JSCBs is the second largest type of credit institutions in the market. Their share of total asset and credit grew from 11.86% and 11.76% in 1997 to 32.45% and 26.54% in 2008 respectively (SBC, 2017). JSCBs have a smaller capital size, which is roughly 2000-3000 billion VND (100-150 million USD), compared to SOCBs. They focused on lending to small-medium enterprises and services for individual customers (Quach, 2011).

#### *2.2.3.2. Security and financial markets*

In 1996, State Securities Commission (SSC) was established to manage the securities market operations. Before 2006, SSC is an independent agency under the supervision of Ministry of Finance (MOF), and in 2006, it became a part of MOF.

The stock market was founded in 2000, and there are two stock exchanges in Hanoi and Ho Chi Minh City. In 2006, the Law on Securities Market was introduced to support the development of corporate bonds and equity markets and revised in 2010. Since its establishment, the stock market has expanded considerably as the market capitalization increase from 0.4% of GDP in 2003 to 14.8% of GDP in 2011 (World Bank, 2011).

According to Nguyen (2014), the stock market has succeeded in helping companies and government to mobilize capital and strengthen the disclosure of SOEs.

After 2007, due to the Financial Crisis, the stock market capitalization dropped dramatically from 27.5% of GDP in 2007 to 10.5% in 2008 (World Bank, 2011).

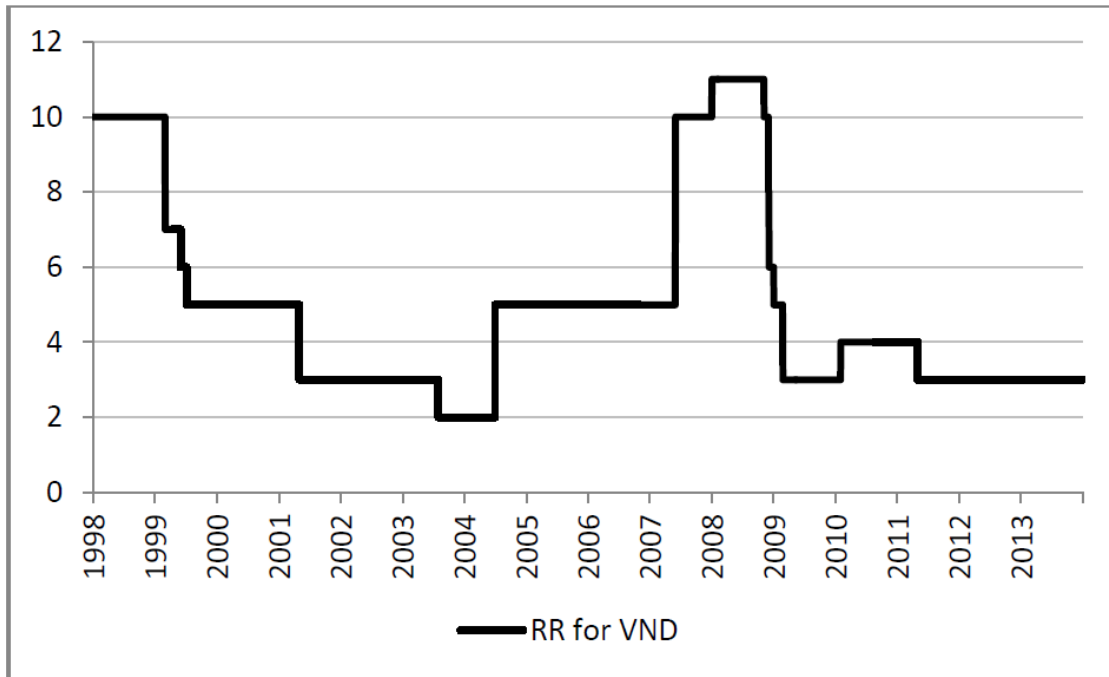
Moreover, VNI index also decreased significantly from 1000 points in early 2007 to 300 points in 2009. To mitigate the negative impact of Financial Crisis, the government issued several decrees regarding taxes on investor and quota on investments from foreign investors in 2009. Moreover, the government also accepted bailout package to leverage and avoid the collapse of the market.

### **2.2.4. Instruments and innovations of monetary policy in Vietnam**

#### *2.2.4.1. Reserve requirement*

Reserve requirement was introduced in 1990, and had been used extensively by SBV before 2000 as a major instrument of monetary policy in Vietnam, but has become less important later due to the introduction of new instruments, namely open market operation. Reserve requirement levels are categorized and determined based on these following criteria: maturity, denominated currency, and types of credit institutions (SBV, 2009). The reserve requirement levels for deposits in credit institutions, which provide funds and involve in activities to promote the development of the rural area, are lower than those of other banks are. Furthermore, the average ratio for deposits in VND is significantly lower and less volatile than that in foreign currency (Pham, 2016).

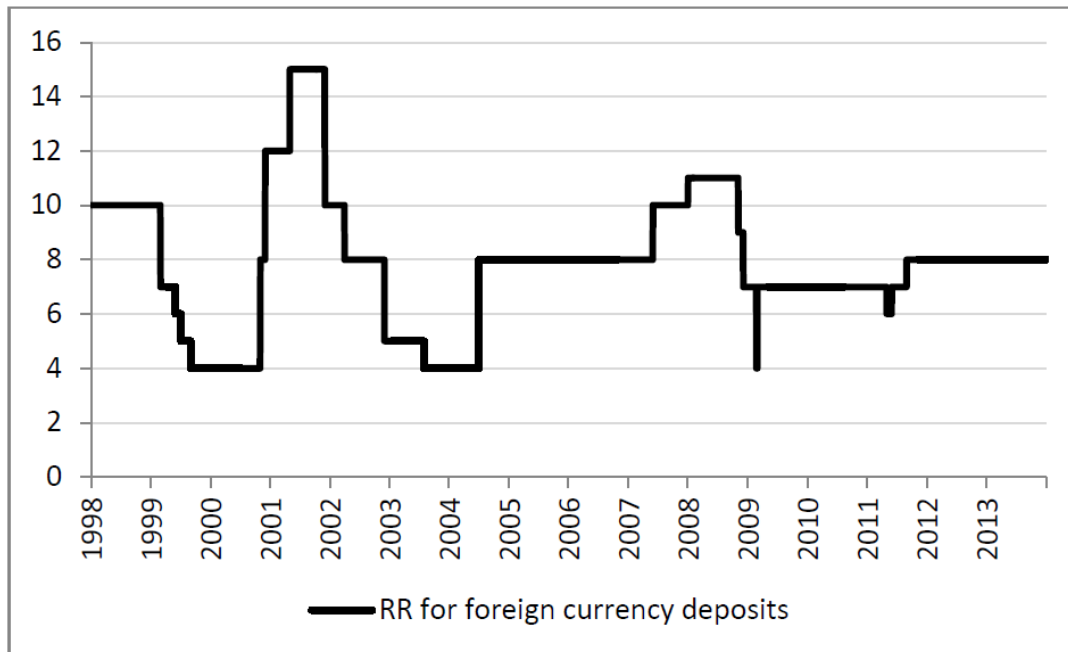
Figure 2: Reserve requirement for VND 1998-2014



Source: Pham (2016: 24).

For deposits in VND, there are two remarkable movements of reserve requirement ratio happening in 1998-2000 and 2007-2009. In details, in 1998-2000, the reserve requirement ratio dropped from 10% to 5%. This decrease is an attempt of SBV to mitigate the negative influence of the Asian Financial Crisis 1997 on state-owned commercial banks (SOCBs) in Vietnam (Shimomoto, 1999). Similarly, noticeable adjustments were made during the period from mid-2007 to the beginning of 2008 when the ratio increased from 5% to 11% in less than one year. Due to WTO's accession in 2007, a considerable credit expansion and inflation pressure from externalities of increasing world commodities prices drove SBV to modify the reserve requirement to reduce the negative effects on the economy. Furthermore, after the Financial Crisis 2007-2008 already affected Vietnam, SBV decreased the ratio rapidly from 11% to 3% within 3 months to alleviate consequences of the crisis and increase the liquidity of the economy to encourage consumptions and investments (Pham, 2016).

Figure 3: Reserve requirement for foreign currency 1998-2014



Source: Pham (2016: 25).

Considering deposits in foreign currency, there are significant modifications to reserve requirement ratio in three periods 1997-1999, 2000-2001, 2002-2003 and 2007-2009. Adjustments to the ratio of deposits in foreign currency in 1997-1999, and 2007-2009 are corresponding to those of deposits in VND in 1998-2000, and 2007-2009. The purpose of these changes is similar and mentioned in the previous section. However, adjustments occurred in 2001-2002 are more aggressive and exceptional than those in the other two periods. From the end of 2000 to mid-2001, the ratio increased from 4% to 15%, and this policy was implemented to counter the undesirable effect of dollarization in the economy by stimulating the convert from USD to VND (Asian Development Bank, 2001). The ratio then reduced to 4% after the policy was effective, but increased to 8% in 2004 and remained constant afterward. This increase was intended to curb the rising inflation but could not produce the desirable effect (Camen, 2006).

#### 2.2.4.2. Interest rate

There are two kinds of instruments, which SBV uses to control the money market. The first one is the base rate, and the second is the discount and refinancing policy.

- Base rate:

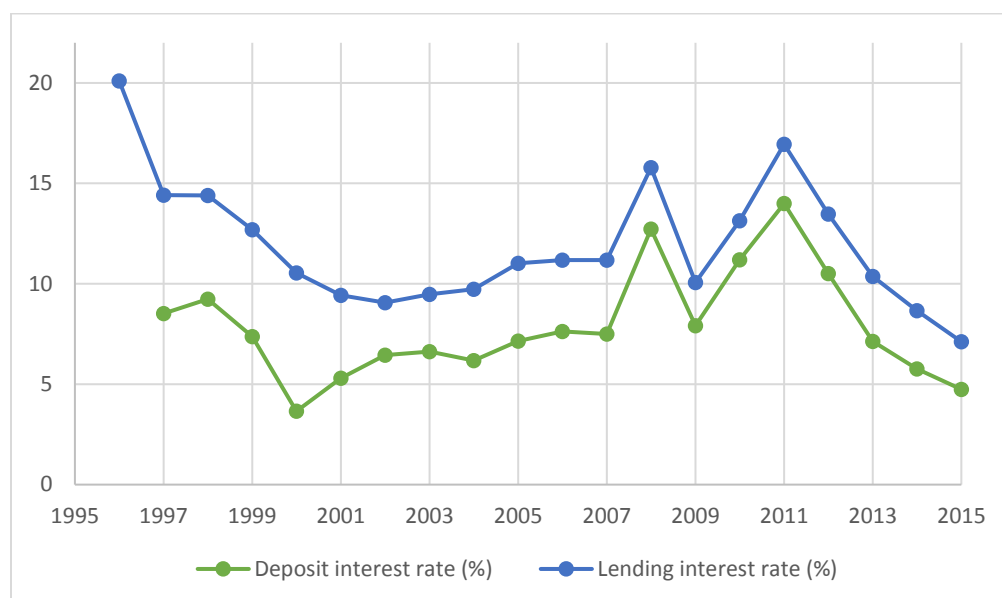
*Table 1: The liberalization of interest rate in Vietnam in 1992-2012*

Date	Changes
Before 6/1992	Specified interest rate
6/1992 - 1995	Announce the mechanism of positive interest rate, and manage through floor and ceiling rates
1996 - 6/2002	Remove ceiling rate; introduce the mechanism of base rates, and allow for deviations within specified bands
6/2002 - 5/2008	Allow for negotiable lending rates
5/2008 - 2/2010	Introduce ceiling rate again
2/2010 - 4/2010	Determine the base rate for short term, and allow for negotiable interest rate for mid and long term loans.
4/2010 - now	Implement completely negotiable interest rate

Source: To et al. (2012)

Before 1992, SBV kept the lending and deposit interest rate under strict control. However, SBV has gradually liberalized the interest rate and moved towards a more flexible and indirect approach since 1992 as illustrated in the table above.

Figure 4: Lending and deposit interest rate in Vietnam in 1992-2015



Source: World Bank (2017)

The figure above represents movements of interest rate from 1996 to 2015. There are two periods with remarkable changes in both deposit and lending interest rates, which are 2007-2009, and 2009-2012. For the movements in 2007-2009, due WTO's accession in 2007, there was a massive credit expansion, and to counter the effect of this expansion, SBV introduced again a ceiling rate but removed it immediately after the money market was already stabilized. After Financial Crisis 2007, together with other stimuli, SBV reduced the interest rate and attempted to inject liquidity into the economy. From 2009 to 2011, the economy recovered from the crisis, but inflation also increased dramatically and reached a peak of 18.67% in 2011. SBV responded to this rise by setting a cap rate on deposit activities of 14% and brought down the base rate to less than 10% by the end of 2012 (Nguyen, 2014 and Pham, 2016).

- Discount and refinancing policy:

This is the indirect instruments of SBV to influence the interest rate on the market and was introduced in 2000. The discount facility provides short-term loans and payment facilities, namely mortgaged loans and discounting valuable papers (bonds, fund certificates, promissory note, debentures), for credit institutions. Refinancing facility can



be applied to a larger range of loans and payment facilities with higher value but riskier. There is a quota for discount facility, and both facilities demand collateral (Le and Pfau, 2009; Pham, 2016).

#### *2.2.4.3. Open market operation*

SBV began to use open market operation in 2000, and types of securities, the number of financial institutions involving and open market operation sessions has increased substantially since then. Moreover, this tool has become more important for SBV so order to inject liquidity into the financial system as it contributed to 80% of total liquidity of SBV in 2008 (Pham, 2016).

#### *2.2.4.4. Exchange rate*

Before 1999, SBV determined and followed an official scheme to manage the exchange rate. Starting on 1996, SBV switched to a more flexible approach as it first allowed for an exchange rate band of 1%. There were significant adjustments to the exchange rate in 1997-1998 because VND was overvalued due to the Asian Financial Crisis 1997. The band increased to 5% in February 1997, and to 10% in October 1997. Moreover, there were two devaluations of VND relatively to USD in 1998 with a total decrease of 16.3% of VND. The band stayed at 7% after the crisis.

From 1999, SBV erased the official scheme and manage exchange rate through interbank markets only (Kovsted et al., 2003). SBV announced the official exchange rate based on the average VND/USD exchange rate of the previous day on interbank markets. Banks can determine their exchange rates from this official rate and the inter-bank trading band of SBV. Moreover, SBV has announced a plan for a convertible VND in 2010 to reduce the effect of dollarization (Nguyen and Nguyen, 2010).

SBV relaxed its regulations for foreign exchange market in 2003. Furthermore, in 2005, the government agreed not to place any restrictions on foreign currency transactions under International Monetary Fund (IMF) Article VII, and make any currency arrangement without the acceptance of IMF (IMF, 2006). However, according to Nguyen (2014), foreign exchange management is still inefficient with the presence of dollarization in the economy.

### **3. LITERATURE REVIEW**

This section will present previous researches about monetary policy in Vietnam and related issues. The literature review starts first with a summary of the theory about monetary transmission mechanism and possible influences of external factors on domestic variables. Next, a brief reflection on studies about monetary policy in Vietnam will be conducted. Finally, studies about inflation in other Asian countries and Vietnam will be examined. The rationale behind this examination is due to the fact that monetary policy is suggested widely in literature to control inflation (Bernanke et al., 2001).

#### **3.1. The cause of inflation**

##### **3.1.1. Effects of monetary policy**

Monetary and fiscal policy are nowadays widely used to tackle problems in an economy in the short term to bring the economy back to its natural stage, and most countries when using monetary policy aim for price stability (Loayza and Schmidt-Hebbel, 2002). Moreover, the effect of monetary policy through different mechanisms of transmission will ultimately reflect in aggregate output and prices (Loayza and Schmidt-Hebbel, 2002; Nguyen, 2014). Therefore, to evaluate a certain monetary policy, researchers usually investigate the relationship between inflation, output and macroeconomic proxies of the policy's effect on the money and asset markets. As a result, studying the interaction among inflation and these variables in the economy of Vietnam can help to understand the effectiveness of monetary policy in Vietnam, and discover the main determinants of inflation in order to provide appropriate suggestions for policy-makers. The following section will discuss four channels for monetary transmission mechanism and their relevance to inflation in a small open economy such as Vietnam.

##### *3.1.1.1. The interest rate channel*

When governments adopt a contractionary monetary policy, the central banks will increase interest rate. This rise in the nominal interest rate can result in an increase in real interest rate as expectations of price and price are likely to remain unchanged in the short run, or a decrease in money supply will make real interest rate increase, and this increase of real interest rate leads to a reduction in consumption and investment. In other words, keeping money in banks would give more earnings, and since the cost of

investment rises, firms are less likely to borrow from banks. The contraction in consumption and investment will cause aggregate demand to fall. A decrease in investment and aggregate demand signals a decrease in output. This fall discourages the demand for labor and is likely to increase unemployment, which will be followed by a fall in inflation, or deflation as the Phillips Curve depicts (Frisch, 1983; Loayza and Schmidt-Hebbel, 2002; and Nguyen, 2014).

According to Taylor (1995), interest rate channel is the major channel for transferring the effect of monetary policy to behaviors of agents in the economy. This view is consistent with that of Keynesian and New Keynesian economists (Clarida et al., 2000). Empirical studies in many countries provide statistical support for this claim, for example, Cagliarini and DeBelle (2000), Leiderman and Bar-Or (2000), and Claus (2011).

#### *3.1.1.2. The credit channel*

Mishkin (1995) categorizes the credit channel into two smaller channels, which are the bank-lending channel and the balance-sheet channel.

In the bank-lending channel, the mechanism operates as follows. A contractionary policy creates a shortage of money in the economy, and thus causes a reduction in banks deposits. This situation can make it difficult for firms to borrow, and lower the number of bank loans. Because fewer firms can borrow money and finance their activities, investment in the economy will be likely to decrease. As a result, output possibly falls and leads to a decline in demand for labor, which increases unemployment and decreases inflation. This channel can be crucial to developing countries where the financial market is underdeveloped, and banks are major intermediate agents between borrowers and lenders (Mishkin, 1995).

According to Mishkin (1995), the second channel functions based on the net worth of firms. A money shortage with higher interest rate can cause equity prices and the value of financial assets to fall, and increase the cost of capital. As a result, adverse selection and moral hazard can occur and increase in the market. More precisely, firms or borrowers would have an inclination to suppress information about this decrease in net worth and make it more difficult for lenders to obtain information about the real value of the particular collateral. This imbalance of possessed information is called adverse

selection. Moral hazard happens because a reduction in the value of company drives managers to undertake riskier projects with the higher rate of return while providing misleading information about the actual risk, and consequently, investors, lenders, and customers have to bear more risks of this certain decision. This situation results in a reduction of reliability and leads to a shrinkage in borrowing-lending activities. Therefore, investment can reduce and make output fall. As aforementioned, the ultimate outcome of this recession is a decrease in inflation.

Studies in developing countries such as Kubo (2008) about Thailand and Sharifi-Renani (2010) about Iran confirm the major role of credit channel in transmitting the effect of monetary policy to the economy.

#### *3.1.1.3. The exchange rate channel*

Exchange rate channel is relevant to countries engaging in international trade. As Mishkin (2006) claims, an appreciation will make the domestic currency relatively more expensive than the foreign ones, and in turn, make the price of domestic to foreign goods rises. Therefore, net export and output will conceivably decrease, and thus, decrease inflation. Furthermore, the reduction in prices of imported goods also contributes to the reduction of inflation.

However, it is worthy to note that exchange rate in Vietnam is largely controlled by the State Bank of Vietnam (SBV) and pegged against eight currencies of trading partners (SBV, 2017). Prior to 2007, although there are some depreciations of the dong in response to the market condition and USD value, SBV only allowed for a small fluctuation of the exchange rate with the band of less than ten percent VND/USD. After WTO accession SBV affects exchange rate through inter-bank markets only and seems to gradually move towards a more flexible policy for exchange rate as noted before (Pham, 2016). Nevertheless, given the dollarization of Vietnamese economy (Goujon, 2006 & Pham, 2016), the effect of a fixed exchange rate regime is still relevant and valuable to take into consideration when evaluating the exchange rate channel. As stated by Blanchard and Sheen (2013), the effect of a fixed regime is transitory and dwindles in the long term.

#### *3.1.1.4. The asset-pricing channel*

This channel is mainly developed from Tobin's  $q$  theory (1969), which is based on how monetary policy might affect the valuation of companies in the economy. A decrease in money supply and an increase in interest rate can cause stock prices to fall. This situation limits the ability of firms to finance its activities as the cost of capital increases due to rise in interest rate and rise in the cost of equity from issuing stocks. Consequently, a reduction in investment is likely to occur and cause output to fall, which in turn leads to a decrease in inflation. In addition, according to Mishkin (1995), another influence of the asset pricing channel on behaviors of agents within the economy is through the effect on the wealth of consumers when asset prices decrease. As claimed by Modigliani and Brumberg (1954), Ando and Modigliani (1963), and Friedman (1957), a possible reduction in lifetime wealth will discourage spending and lower consumption. Following the previous logic, this circumstance lowers output and creates a drop in inflation.

Along with the maturity of capital markets, especially equity markets, in emerging economies, this channel is gaining more importance in transferring the effect of monetary policy, and this statement is fostered by empirical studies in developing countries, namely that of Pong and Wong (2011). However, in the context of Vietnam, this channel will be discussed in depth in the last section of this literature review.

#### **3.1.2. Effects of external factors**

As discussed in studies of Nguyen et al (2012), and Nguyen (2014), rice and oil prices can act as two major proxies to reflect the influence of external factors on inflation in Vietnam. According to Goujon, because rice is a major commodity item and an exportable good in Vietnam, an increase in export rice can create a shift in domestic supply and lead also to an increase in domestic rice price. This increase in domestic rice price might lead to an increase in price level. While Vietnam is one of the largest rice exporters, as a small and open economy, it is a price-taker in the global market (2006). Therefore, one can expect to see some impact of world rice price on inflation in Vietnam. Furthermore, crude oil constitutes a remarkable proportion of Vietnam's export, but Vietnam has imported a large quantity of final goods of oil for domestic consumption, and money from exporting oil has been used to repay foreign debts (Pham, 2016). It is reasonable to assume that

policy makers in Vietnam should be aware of the fluctuation of oil price and adjust its monetary policy accordingly to maintain price stability in the economy.

### **3.2. Studies about monetary policy in Vietnam**

Most studies about monetary policy in Vietnam only deal with a specific aspect, namely exchange rate, inflation, and real money demand. Because this study places a significant part on analyzing the effect of macroeconomic variables on inflation, studies about inflation in Vietnam will be investigated in a separate part. Therefore, this section only includes studies on exchange rate and real money demand.

In general, studies about exchange rate in Vietnam have expressed disagreements with the regime adopted by policy marker now in Vietnam. After investigating the current exchange rate regime, Mai (2007) suggests that the current macroeconomic conditions in Vietnam are appropriate for changing to a floating regime, and a proposal to gradually changing from the current regime to a floating one. Nguyen and Nguyen (2009) claim that the exchange rate regime in Vietnam has led to the failure of foreign exchange rate market. However, some studies find that the exchange rate regime that SBV follows is effective in dealing with some problems. For instance, according to Vuong and Ngo (2002), the exchange rate system in Asian Crisis in 1997 had helped to prevent a significant appreciation of the domestic currency, which can result from the devaluation of other currency in the area. Moreover, in the 1990s, the government succeeded in controlling inflation by using effectively the exchange rate and a restrictive monetary policy.

Moreover, some studies about the real effective exchange rate of Vietnam also make some recommendations for a better monetary policy. Nguyen and Kalirajan (2006) support for devaluations can help with exports, account balance and weaken the appreciation of the real exchange rate. Menon (2009) recommended that the policy makers should modify the real exchange rate corresponding to the increase in capital inflow.

Researches about real money demand in Vietnam focus on studying its drivers. Empirical results show that in 1993-2004, income, interest rate, inflation, and rate of return of USD deposits decided the demand for VND (Shinichi and Pham, 2005). There existed a

positive relationship between inflation and the growth rate of broad money, and the disequilibrium between money supply and demand of VND seemed to take approximately 15 quarters to disappear. Another study by Nguyen and Wade (2010) using data from 1999 to 2000 also confirm the role of income in determining the real money demand for domestic currency. Moreover, there is evidence of dollarization in the economy and the impact of inflation on real money demand. Nevertheless, there is insufficient statistically evidence for an impact of interest rate, and this phenomenon might indicate that the ineffectiveness of interest rate policy during this period (Nguyen and Wade, 2010).

In conclusion, the incomprehensiveness of above studies about inflation in Vietnam makes it difficult to construct insightful recommendations for monetary policy in Vietnam. Moreover, due to the rapid changes in the world economy recently, an updated study might be necessary.

### **3.3. Empirical studies of inflation in other Asian countries**

This section will examine studies about inflation in some countries in Asia. The scope of discussion will be limited to these following countries and regions: Malaysia, China, Singapore and Hong Kong. Although inflation in these countries is considerably different from that in Vietnam (WB, 2017), examining studies on inflation of these countries can provide some insights for the research on Vietnam's. Malaysia represents a newly industrialized emerging economy, which was transformed from an agricultural and mining economy in ASEAN (Drabble, 2001). China is the major trading partner of Vietnam for both import and export (WITS, 2015). Singapore is also a member of ASEAN and has an exchange rate regime similar to that of Vietnam as both countries follow a stabilized arrangement (IMF, 2016). Finally, Hong Kong is one of the main exporting markets of Vietnam (WITS, 2015) and the two both have an economically and politically strong link with China.

For Malaysia, inflation has reacted to movements of domestic variables as described below. Zaidi and Fisher (2010) claim that a shock in interest rate will cause inflation to fall, but the effect is temporary, lasts for approximately eight quarters, and disappears in the long run. A study by Jongwanich and Park (2009) provides empirical support for a declining and limited impact of exchange rate on inflation as the time horizon increases.

This phenomenon is supported by Zaidi and Fisher's research since an appreciation makes inflation decrease immediately, but after six quarters, inflation will revert to the initial level (2010). The effect of output gap upon inflation enlarges over time on 1999-2008 (Jongwanich and Park, 2009). However, in a study conducted by Zaidi and Fisher (2010), the reaction of inflation to an increase in output is inconsiderable and temporary. Moreover, inflation responds positively to a shock to interest rate and stock prices, but this reaction maintains only in the short term, and these two variables overall explain only a little part of the inflation variance (Zaidi and Fisher, 2010).

Nevertheless, inflation in Malaysia rises more strongly in response to external shocks than to internal ones. Analyzing data from 1999 to 2008, Jongwanich and Park (2009) state that foreign proxies contribute more to the variation of inflation than domestic ones do, and the impact of foreign factors amplifies over time. This finding is similar to that of Zaidi and Fisher (2010).

In China, according to Jongwanich and Park (2009), foreign factors have a remarkable contribution to inflation variance, but this contribution is comparatively small to that of domestic factors, and among domestic variables, exchange rate exerts the most insignificant impact on inflation while output gap and expectation are two major explanatory proxies. Furthermore, a study about relationship between inflation and money supply finds no supporting evidence for a causality of these two variables during 1994-2014, which can be attributed to the possible structural changes that appeared in this period (Su et al, 2016). To obtain a more comprehensive picture, these researchers construct tests on sub-samples and find a bilateral causal relationship between inflation and money supply, but the effect on each period varies (Su et al, 2016). Moreover, findings in study by Zhang and Clovis (2011) suggest that inflation in China has become less responsive to structural innovations and observed a reduction in inflation persistence. This improvement is attributed to better monetary policy (Zhang and Clovis, 2011).

For Singapore, similar to China, external factors account for inflation variance less than internal factors do, and among all the variables, the effect of expectation is largest; those of oil price and output gap are relatively identical and considerable, while others are negligible during 1999-2008 (Jongwanich and Park, 2009). Estimating over a longer time



horizon 1984-1999, Cheung and Yuen (2002) find that in the first six years, internal factors have more impact on inflation variance than external factors, represented by US shocks, do. However, external factors gain more weight in explaining for variation of inflation over time (Cheung and Yuen, 2002).

Finally, in the context of Hong Kong and its fixed exchange rate regime, which is pegged against US dollar, one could expect to observe an enormous reaction of inflation against shocks in USD. Accordingly, the study by Cheung and Yen (2002) confirms this statement since the effect of foreign shocks becomes larger than that of domestic only after three and a half years, and the magnitude of this effect is remarkably greater than that in Singapore.

In general, the determinants of inflation in those aforementioned countries vary. It appears that exchange rate only has a limited impact on inflation, and external factors seem to have a significant contribution to inflation. However, the analyses of these countries provide some interesting suggestions for policy-makers in Vietnam. For instance, the success of monetary policy to reduce inflation and inflation persistence in China offers a good recommendation, or in the case of Singapore, despite some basic differences, policy makers in Vietnam could infer some implications due to the similarity of exchange rate regime, a stabilized arrangement.

### **3.4. Empirical studies of inflation and monetary policy in Vietnam**

Researches about inflation in Vietnam usually focus on finding and evaluating the impact of several variables. The chosen proxies are usually M2, credit to the economy, interest rate, nominal exchange rate, and the commodities price represented by oil and rice prices. By analyzing data and estimating the relationships between these variables and inflation, researchers are able to deduce some implications about the effectiveness of and suggestions for monetary policy in Vietnam. However, these studies provide different and even conflicting results about the drivers of inflation in Vietnam.

Firstly, the impact of monetary and credit aggregates on inflation in Vietnam is inconclusive. Some researches show that inflation is largely explained by credit to the

economy, but the impact of money supply, M2, on inflation is insignificant. In fact, other researches indicate that money supply could be the main source of inflation in Vietnam.

Using data from 1999 to 2013, Bhattacharya (2014) claims that growth in credit to the economy has a positive impact on inflation after two to ten quarters- a medium period, but gives no conclusion about the relation of money supply, represented by M2, and inflation in Vietnam. In accordance with the previous result, using quarterly data from 1996-2005, there is no statistical evidence that money supply measured by M2 causes inflation (Le & Pfau, 2009). Similarly, the results of the analysis on 1996-2005 and 1996-2004 show that credit to the economy has a remarkable impact on CPI, at the two-year horizon, or to be more specific, 25 percent of the variance of the inflation index can be explained by this variable. However, the estimation over the period from 1996-2003 produces a contradictory outcome as credit only explains a small part of the variance, and across three samples, the variable M2 has an inconsiderable contribution to inflation (Camen, 2006). Consistently, from 1995 to 2003, empirical results suggest that broad money growth can only explain approximately ten percent of the headline inflation, and the effect dwindles after approximately six quarters (IMF, 2003).

However, a research conducted by IMF (2006) covering 2001-2006 proves that the M2 money supply has a significant influence on the CPI, the chosen indicator of inflation, in Vietnam. Correspondingly, the effect of monetary policy measured by M2 is the source of inflation during 2000-2010 (Nguyen and Nguyen, 2010). As Nguyen (2014) proves, although, in the short term, money supply appears to have no remarkable relationship with inflation, the effect of money supply increases dramatically in the medium and long term.

The impact of credit to the economy on inflation is relatively considerable overestimated periods except for period 1996-2003. Although the effect of money supply represented by M2 varies with chosen periods, by comparing those chosen periods, it is likely that the estimation over the periods involving years before 2000 results in an insignificant impact while that over period after 2000 gives a contradictory outcome.

Secondly, considering the nominal effective exchange rate, estimations of the impact on inflation are also substantially different. The analysis of inflation from 1999 to 2013

conducted by Bhattacharya (2014) indicates that the movement of exchange rate largely explains the dynamics of inflation in the short term. Consistent with this finding, the exchange rate- VND/USD contributes significantly to inflation as it accounts for nearly 19% of error variance, and this result is considerably robust across all three samples: 1996-2005, 1996-2004, 1996-2003 (Camen, 2006). Furthermore, in the analysis of period 1991-1996, Goujon (2006) claims that the exchange rate is the main inflation determinant.

However, the nominal effective exchange rate has a modest impact on inflation during 2001-2006, and this is partly due to administered prices, as the government imposed restrictions on the domestic price of commodities to hedge against the volatility of world price, and the stability of exchange rate during that period (IMF, 2006). Evidence from a previous study on inflation from 1995-2003 by IMF (2003) also confirms that the impact of exchange rate on inflation is middling, especially on consumer prices in contrast to a significant influence on import prices. The exchange rate also exerts a moderate impact on inflation as one percent depreciation leads to 0.16 percent of inflation during 2000-2010 (Nguyen and Nguyen, 2010).

In a recent research covering 2000-2011, Elgammal & Eissa (2016) argue that exchange rate statistically contributes to inflation at 5% confidence level. Estimating over period – 2001 to 2009, Nguyen et al. (2012) prove that the effect of exchange rate is insignificant. Results from the study over 1999-2008 also yield a resembling conclusion as exchange rate accounts for less than 10% of inflation variance in Vietnam (Jongwanich & Park, 2009). During 2000-2011, exchange rate appears to exert limited influence on variation of inflation, and this effect decreases as the time horizon increases (Nguyen, 2014).

It appears that no conclusion about the impact of exchange rate can be reached due to the considerable difference in estimated results, even those of similar periods, namely those of 2000-2010 by Nguyen and Nguyen (2010) and 2000-2011 by Nguyen (2014). This discrepancy can be the consequences of various models and methods that these authors choose and/or changes in exchange rate policy.

To obtain a comprehensive depiction of the relationship between inflation and exchange rate, some researchers find statistical evidence that inflation in Vietnam can account for the movements of exchange rate before 2007. Inflation appears to moderately Granger

cause the exchange rate depreciation from 1993-1998 (Nguyen & Kalirajan, 2005). Consistently, the real exchange rate can be explained by lags of price level when conducting the test for all three samples: 1992-2005, 1992-1999, 1999-2005, and price level accounts for 65 to 70% of the real exchange rate variance from 1992-2005 (Nguyen & Fujita, 2007). Unfortunately, there are few researches examining the impact of inflation on the exchange rate after 2007. This relation is worth studying especially when increasing capital inflows after Vietnam's WTO accession in 2007 and the tendency to move toward a flexible regime of SBV can limit the ability to use exchange rate as an operation to maintain price stability and economic growth as implied by Pham (2016).

Most researches have demonstrated that the impact of interest rate on inflation is uncertain. In a study by Camen (2006), interest rate accounts for a negligible amount of inflation variance, which is less than five percent in all three samples. The analysis of data from 2001 to 2009 also provides empirical support for an inconsiderable contribution of interest rate to inflation variance (Nguyen. et al, 2012). However, an empirical analysis using data from the recent period, 1996-2012, proves that interest rate is an important contributor to the variation of inflation (Phan, 2014), and this result is consistent with the study covering 2000-2011 of Nguyen (2014). Moreover, interest rate affects inflation significantly in the first two quarters during 1996-2013 (Bhattacharya, 2014). A distinction between ante-2008 studies and post-2008 studies is likely to suggest that interest rate channel might be enhanced to become an important instrument of monetary policy to control inflation.

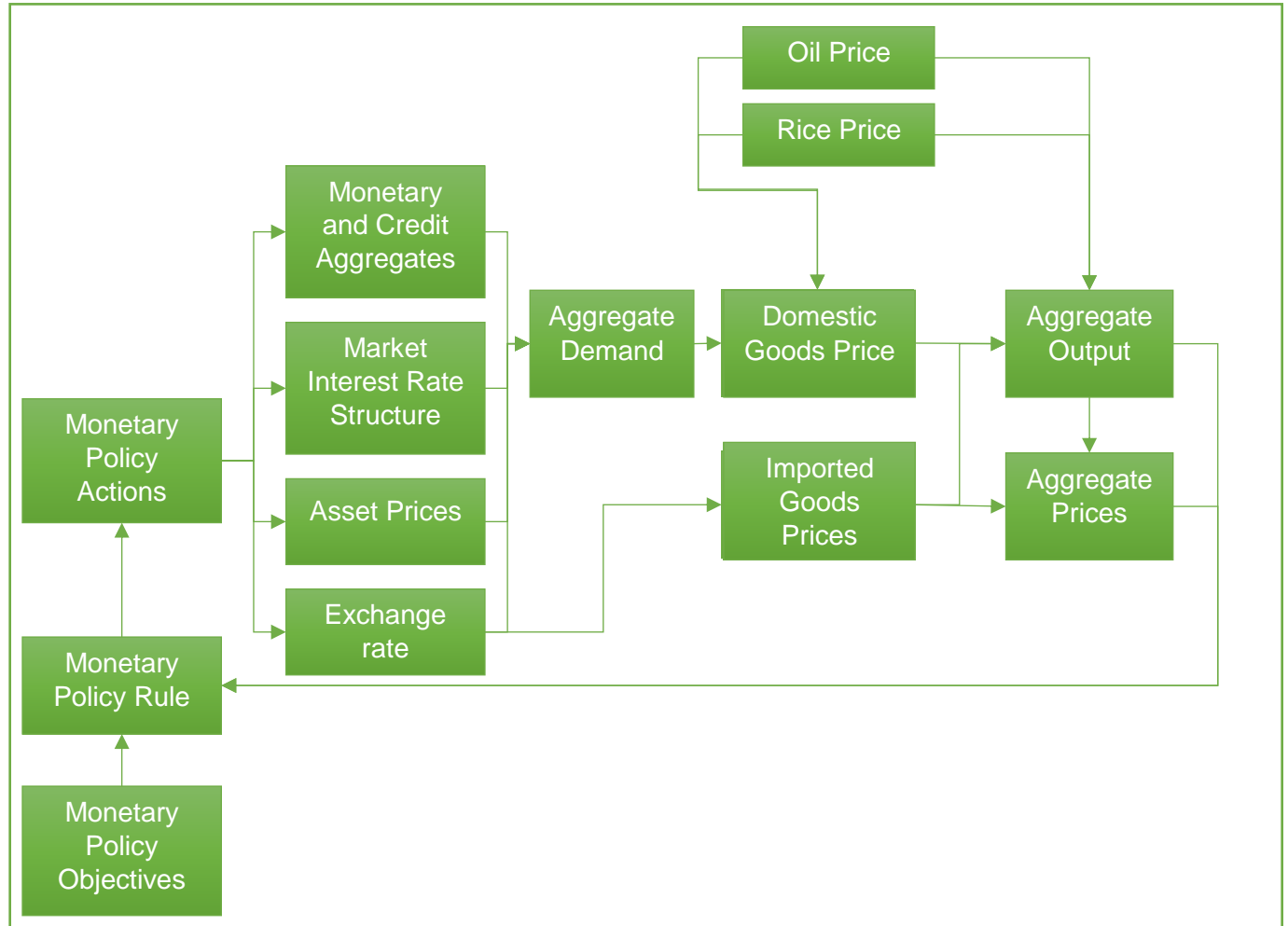
Besides those prominent internal factors, some researchers also mention the relationship between the proxy for asset pricing channel for monetary transmission mechanism and inflation. Le and Pfau (2009) argue that because the stock exchanges in Vietnam are only founded in 2000 and relatively limited in size with few players and openness, this channel is irrelevant to the study. Furthermore, findings from a study by Nguyen (2014) show little support for such a relationship as the stock index accounts for approximately five percent of inflation variance. Therefore, it would be unreasonable to include this channel when the stock exchanges, or in general the financial market are still immature.

Regarding how external factors influence inflation in Vietnam, there exists a considerable gap between the impact of oil and rice price, and studies seem to agree that while the effect of rice price on inflation is statistically significant, oil price exerts only a negligible impact. For instance, analyzing data from 1999-2008, Jongwanich & Park (2009) claim that the main driver of inflation is food price as it explains over 30% of the inflation variance, while less than 10% of variance can be explained by movement of oil price. For period 1996-2012, the impact of rice price on inflation among other external factors is the most significant one, but that of oil price is unnoticeable (Phan, 2014). As IMF (2003) states, a large portion of inflation variance is attributed to rice price as compared to the effect of oil price on movement of inflation during 1995-2003. Consistently, studies over periods 2000-2011 find no statistical support for a relationship between inflation and oil price (Nguyen & Nguyen, 2010; Elgammal & Eissa, 2016). However, during 1996-2005, the impact of oil and rice price on inflation varied enormously across estimated models and periods, but overall, the combined effect accounts for at least 30% of variation (Camen, 2006), and this result is similar to that of Nguyen (2012) and Nguyen (2014). From previous studies, the impact of external factors is comparatively strong, and this finding suggests policy makers might consider adopting a policy to mitigate this impact. As recommended by Nguyen & Nguyen (2010), a more flexible exchange rate regime would help to counter the effect of foreign factors, and Bhattacharya (2014) suggests a liberalization of interest rate is likely to be more efficient to maintain price stability as well as reducing the impact of foreign factors.

To conclude, from preceding researches, the determinants of inflation in Vietnam can be external factors, interest rate for researches conducted on post-2008 periods, and money supply for studies after the year 2000. These results suggest that there might be an increase in the effectiveness of monetary policy as two major monetary transmission channels namely the interest rate and credit channels seems to gain more importance in transferring the effect to the economy. Moreover, the decisive role of foreign variables in influencing movement of inflation implies that policy-makers should be vigilant against these factors to make an appropriate adjustment to lean against their negative effects. However, there is an inconsistency in results of different estimated periods, and this phenomenon might indicate that the government has adopted a monetary policy to

accommodate changes in Vietnamese economy across years. Therefore, an updating analysis is of vital importance to reflect the impact of monetary policy in the recent period.

### 3.5. Conceptual framework.



Source: Adapted from Loayza and Schmidt-Hebbe (2002).

## **4. METHODOLOGY**

### **4.1. A discussion of VAR, SVAR models and VECM**

In the context of Vietnam, with a relatively limited data, approaches without the requirement for good-quality data are the most appropriate. These include vector autoregressive (VAR), vector error correction model (VECM), and structural vector autoregressive (SVAR).

VAR approach has been widely used to evaluate the effects of monetary policy, especially through monetary transmission mechanisms, starting after the work of Sims on 1980. VAR method allows for a comprehensive examination of dynamic relationships among variables with a surprising simplicity (Asterious and Hall, 2011). Moreover, with a lack of consensus on the structural model of the economy, VAR model seems to provide approximately good estimations of the effects of monetary policy (Rudebusch, 1998). However, this method has some critical drawbacks such as the difficulty to reach any conclusions from a large number of estimated coefficient and to infer the economic implication of estimated parameters (Pham, 2016).

VECM accounts for both short run and long run effects, can eliminate trends existing in variables, and corrects errors of the regression in the long run (Asterious and Hall, 2011). However, one major disadvantage of this method is that it assumes all shocks are permanent, so the effects of temporary shocks can be misspecified (Nguyen, 2014).

SVAR is a development of VAR, which aims to remove the disadvantages in VAR approach (Pham, 2016). In SVAR, before estimating, certain assumptions about relationships between variables based on economic theory is added to provide better results from estimations, and it helps to provide some inferences for parameters of models and describe precisely whether a particular shock is permanent or temporary (Nguyen, 2014 and Pham, 2016).

### **4.2. Structural VAR for a small open economy**

Based on the discussion above, for this study, an SVAR approach is adopted to examine the relationships between chosen macroeconomics variables relating to monetary policy. SVAR models are constructed using results from researches of Kim and Roubini (2000),

Nguyen (2014), and Pham (2016) to describe the effects of monetary policy through channels of monetary transmission mechanism.

### 4.3. Introduction of structural VAR models

The structural form of an SVAR model is:

$$A_0 Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t \quad (1)$$

Where:  $Y_t$  is a  $(n \times 1)$  vector of endogenous variables.

$Y_{t-i}$  ( $i = 1, \dots, p$ ) is a  $(n \times 1)$  vector of  $i$ -th lag of endogenous variables

$A_i$  ( $i = 0, \dots, p$ ) is a  $(n \times n)$  coefficient matrix of  $Y_{t-i}$

$\varepsilon_t$  is a  $(n \times 1)$  vector of structural innovations.

The model assumes  $\varepsilon_t \sim N(0, \Sigma)$  and  $E(\varepsilon_t, \varepsilon_t') = \Omega$ , where  $\Omega$  is a diagonal matrix. In other words, structural innovations are orthogonal and uncorrelated.

For this model,  $A_i$  and the variance of  $\varepsilon_t$  should be estimated, but one could not do so given the structural form of the SVAR model. Therefore, the model must be transformed into a reduced form by multiplying both sides of (1) with  $A_0^{-1}$ :

$$Y_t = A_1 A_0^{-1} Y_{t-1} + A_2 A_0^{-1} Y_{t-2} + \dots + A_p A_0^{-1} Y_{t-p} + A_0^{-1} \varepsilon_t \quad (2)$$

Simplifying to obtain:

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \dots + B_p Y_{t-p} + u_t \quad (3)$$

Where  $A_i A_0^{-1} = B_i$  ( $i = 1, \dots, p$ ),  $A_0^{-1} \varepsilon_t = u_t$  and  $E(u_t, u_t') = A_0^{-1} \Omega (A_0^{-1})'$  is the variance covariance matrix of  $u_t$ . The assumptions for  $u_t$  are  $E(u_t, u_s) = 0$  ( $t \neq s$ ), and  $E[u_t] = 0$ .

Estimations of coefficient matrices  $B_i$  ( $i = 1, \dots, p$ ) can be used to identify the coefficient matrices in the structural form  $A_i$  ( $i = 1, \dots, p$ ). The structural innovations  $\varepsilon_t$  can be derived from errors  $u_t$  of the reduced form, but certain restrictions must be placed on the system. In details,  $\frac{n(n-1)}{2}$  restrictions must be imposed on  $A_0$  matrix to be able to identify the structural shocks.



#### 4.4. Puzzles

Many empirical researches on the effects of monetary policy in both closed and open economies have found many abnormal responses (puzzles) of macroeconomic variables to monetary shocks, which cannot be explained by economic theories (Kim and Roubini, 2000). In details, there are four typical puzzles:

- The liquidity puzzle: A shock to money supply should appear with a decrease in nominal interest rate, but is found to be accompanying by an increase (Leeper and Gordon, 1991; Kim and Roubini, 2000).
- The price puzzle: An increase in price should lead to a decrease in inflation, but is found to be followed by an increase (Sims, 1992).
- The exchange rate puzzle: An increase in interest rate of the home country should lead to an appreciation of the domestic currency, but is followed by a depreciation (Sims, 1992).
- The forward discount bias puzzle: If uncovered interest parity holds, a relatively increase in the interest rate to foreign ones should be followed by an appreciation and then a persistent depreciation of the domestic currency, but is accompanying by a persistent appreciation (Kim and Roubini, 2000).

The puzzles usually result from the choice of variables and assumptions created in SVAR identification (Pham, 2016).

For instance, price puzzle may arise from using money aggregates to represent adjustments in monetary policy because changes in money aggregates might also reflect money demand shocks (Sims, 1992). Many researchers have suggested using other variables instead of money aggregates such as short-term interest rate (Sims, 1992), and inflationary expectation (Gordon and Leeper, 1994).

Addressing this issue, Kim and Roubini (2000) develop a non-recursive SVAR model to estimate the effect of monetary policy in seven countries, and find that the responses of macroeconomic variables to monetary shocks support the predictions of economic theories. Applying the SVAR model developed by Kim and Roubini (2000) to Indonesian economy and focusing on exchange rate channel, Afandi (2005) finds no existence of an

exchange rate puzzle and shows that a depreciation of domestic currency appears after the implementation of a contractionary monetary policy.

## 4.5. Recursive and non-recursive models

### 4.5.1. Recursive

When estimating the response of variables to temporary shocks using recursive models, one assume that variables are affected following a sequential chain of shocks, or the matrix  $A_0$  is diagonal and takes the form of a lower triangular matrix as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ u_6 \end{bmatrix} = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \end{bmatrix}$$

Specifically, the first variable is assumed to response to its own shocks. The second one is affected by shocks of the previous variable and its own, and so forth. When using recursive model, researchers make assumptions that policymakers only use the available information to design monetary policy (Raghavan et al., 2012).

### 4.5.2. Non-recursive:

Non-recursive models allow for more flexibility, and shocks do not need to affect all preceding variables. As the following model by Kim and Roubini (2000) illustrates, the first variable response to its own shocks, and shocks from the second, fifth, and seventh variables.

$$\begin{bmatrix} 1 & a_{12} & 0 & 0 & a_{15} & 0 & a_{17} \\ a_{21} & 1 & a_{23} & a_{24} & 0 & 0 & 0 \\ 0 & 0 & 1 & a_{34} & a_{35} & 0 & 0 \\ 0 & 0 & 0 & 1 & a_{45} & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & a_{65} & 1 & 1 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ u_6 \\ u_7 \end{bmatrix} = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \end{bmatrix}$$

These models eliminate the strict assumptions about behaviors of policymakers that researchers must impose when using recursive models, and allow for a better estimation,

especially when it is possible for policy makers to implement a policy, which also takes into consideration the unexpected shocks nowadays.

## 5. DATA AND MODEL

### 5.1. Variables

Based on previous researches about monetary policy in Vietnam and researches in other countries, the following variables are chosen to conduct the study:

Foreign blocks: world oil price (OIL), world rice price (RICE), U.S. Federal fund rate (FED).

Domestic blocks: gross domestic product (GDP), consumer price index (CPI), money supply (M1), bank credit (CRE), short-term interest rate (PR), nominal exchange rate (NEER).

Because Vietnam is a small open economy, including foreign variables to account for the external effect, is of vital importance:

- In previous researches about Vietnam, namely IMF (2003), Camen (2006), Nguyen & Nguyen (2010), Nguyen (2014), Pham (2016), world oil price (oil) is also included as a key foreign factor. Moreover, this variable is widely used in researches about monetary policy of other small open economies with SVAR models, namely the studies of Kim and Roubini (2000), and Afandi (2005). Furthermore, crude oil is the main export product in Vietnam, and movements of oil price can affect prices of many products and goods. Therefore, shocks in oil price might have a significant impact on the implementation of monetary policy and domestic variables.
- World rice price (rice) is frequently used in studies about Vietnam with world oil price. Although this variable does not typically appear in an SVAR model about monetary transmission mechanisms in small open countries, Le and Pfau (2009) and Nguyen (2014) argue that it is necessary to account for shocks from rice price to domestic variable because rice is a primary commodity and major exportable good in Vietnam. Moreover, as mentioned above, because Vietnam is a small economy in the world, it appears to be a price-taker than a price-maker, so world rice price should be considered as an external variable.
- Although U.S. Federal fund rate (fed) only appears in few studies about Vietnam, this is a common variable in studies using SVAR approach on the effect of

monetary policy, namely Kim and Roubini (2000), Afandi (2005), Raghavan and Silvapulle (2011). Adding this variable to the SVAR model will help to describe the external shocks to Vietnamese economy more precisely due to the dominant role of US dollar in international exchange, the exchange rate regime as VND is pegged mainly against USD, and the possible dollarization in Vietnam (Goujon, 2006, Nguyen and Nguyen, 2010, and Nguyen, 2014).

The domestic variables are chosen to represent three monetary transmission channels: the interest rate channel, the credit channel, and the exchange rate channel. As discussed in the literature review, due to the immaturity of financial markets in Vietnam, the asset-pricing channel is not included.

- Real GDP and CPI accounts for the primary targets of monetary policy, which are economic growth and price stability in Vietnam. The use of real GDP in this study follows the standard practice in researches about monetary policy (Pham, 2016).
- M1 is the variable of monetary aggregate and reflects the response of SBV to foreign and domestic shocks. While many studies about Vietnam use M2 as the proxy for monetary aggregate (Camen, 2006; Le and Pfau, 2009; Nguyen and Nguyen, 2010, and Bhattacharya, 2014), M1 can be a more appropriate indicator. As Pham (2016) argues, M2 can be influenced by other factors from financial markets than monetary policy as the growth of M2 is substantively larger than that of M1 and M0.
- PR and CRE stand for interest rate channel and credit channel respectively.
- NEER denotes the nominal exchange rate of VND/USD and represents the exchange rate channel. This variable is chosen to reflect the exchange rate channel because movements of USD play an important role in the decision of central bank to adjust the exchange rate, and USD is usually used as the intermediate currency in foreign trade in Vietnam (Goujon, 2006, and Ministry of Industry and Trade Vietnam, 2017).

## **5.2. Data source and adjustments**

Data is collected from trustworthy sources, namely IMF, general statistics of Vietnam, the State Bank of Vietnam, and Ministry of Industry and Trade Vietnam.

Data for all variables except GDP are available in monthly frequency. GDP is only existed in quarterly data and recalculated with 1994 as the base year. This quarterly data of real GDP is then converted to monthly frequency using Denton's method. Finally, all the variables are seasonally adjusted using X-12 ARIMA and in logarithm form except for FED and PR.

Moreover, taken into consideration the effect of WTO accession in 2007, data is broken into two small samples: 1998M10-2006M12, and 2007M01-2016M10. This approach uses the result of test for structural break in trilemma analysis of external influences by Pham (2016). Conducting a similar analysis is beyond the scope of this study. Moreover, when looking at the residual plots (Appendix A), one can see that there is no evidence of the existence of structural break from 2013 to 2016 as the analysis of Pham (2016) covers the period 1995-2013.

### **5.3. Data for an SVAR model**

For empirical studies about monetary transmission mechanisms, researchers usually use two different approaches to estimate an SVAR model with non-stationary data. The first approach is transforming non-stationary time series into stationary time series by taking the first or second differences of the level data (Nguyen, 2010, and Nguyen, 2014). This process is of vital importance to avoid obtaining spurious regression when estimating the model at level values when the data used for the study have unit root. Furthermore, this transformation will also help to increase the quality of impulse response functions and variance decomposition (Nguyen, 2014).

However, taking the differences is criticized for leading to a loss of information, and to account for long-term relationships, it is better to use the level data (Sims, 1992, and Kim and Roubini, 2000). This approach can allow for a better analysis of the dynamic relationships between variables, and one can mitigate the effects of non-stationary data by adding more lags to the model. Nevertheless, other researchers show that the problem of spurious regression still exists in this approach (Berkelmans, 2005, and Aslanidi, 2007).

Because this study focuses on examining the relationships in short-term and medium-term, the first approach will be adopted. Unit root test using the Augmented Dickey-Fuller test will be used to identify whether a variable is stationary.

#### 5.4. Model identification

To set up the SVAR model used in this study, Granger Causality test will be applied to test for possible linkages between macroeconomic variables in three monetary transmission channels:

- The interest rate channel with 4 variables: PR, GDP, CPI, and M1
- The credit channel with 4 variables: GDP, CPI, M1, and CRE
- The exchange rate channel with 5 variables: GDP, CPI, NEER, M1, and EXIM.

This process follows one used by Pham (2016). EXIM is the ratio of total exported value over total imported value of goods each month. Results of these Granger Causality tests are reported in Appendix B.

Moreover, several SVAR models by Kim and Roubini (2000), Nguyen (2014), and Pham (2016) are used as benchmark models to construct the SVAR model of this study.

The SVAR model:

$$A \begin{pmatrix} u_{oil} \\ u_{rice} \\ u_{ffr} \\ u_{gdp} \\ u_{cpi} \\ u_{m1} \\ u_{p\_rate} \\ u_{cre} \\ u_{neer} \end{pmatrix} = B \begin{pmatrix} \varepsilon_{oil} \\ \varepsilon_{rice} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{m1} \\ \varepsilon_{p\_rate} \\ \varepsilon_{cre} \\ \varepsilon_{neer} \end{pmatrix}$$

The contemporaneous matrix (A):

	OIL	RICE	FED	GDP	CPI	M1	PR	CRE	NEER
OIL	1	0	0	0	0	0	0	0	0
RICE	0	1	0	0	0	0	0	0	0
FED	NA	0	1	0	0	0	0	0	0
GDP	NA	NA	0	1	0	0	0	0	0
CPI	NA	NA	0	NA	1	0	0	0	0
M1	0	0	0	NA	NA	1	NA	0	0
PR	0	0	NA	NA	NA	0	1	0	0
CRE	0	0	0	0	NA	NA	NA	1	NA
NEER	NA	NA	NA	NA	NA	NA	NA	0	1



## 6. EMPIRICAL RESULTS AND DISCUSSIONS

### 6.1. Unit root test

Variable	Level			First difference		
	AIC	p-value	Stationary	AIC	p-value	Stationary
FED	-4.1814	0.0055	Yes	N/A	N/A	N/A
PR	-2.5254	0.0115	Yes	N/A	N/A	N/A
CPI	3.1880	0.9997	No	-4.5682	0.0002	No
CRE	0.8540	0.8939	No	-23.9599	0.0000	No
GDP	4.7000	1.0000	No	-5.5089	0.0000	No
M1	4.1923	1.0000	No	-6.8016	0.0000	No
NEER	4.5551	1.0000	No	-17.0265	0.0000	No
OIL	-1.4349	0.8486	No	-12.7621	0.0000	No
RICE	-1.8413	0.6817	No	-6.8847	0.0000	No

The Augmented Dickey-Fuller test shows that except for federal fund rate (FED) and policy rate (PR), all other time series have unit root at the level, and this result implicates that these variables should be differencing before used to estimate the models. Moreover, when testing at first difference, the null hypothesis that unit root exists can all be rejected at five percent significance level, so these first differencing time series can be applied for the SVAR models.

### 6.2. Lag-length criteria & Johansen's co-integration tests results

*Table 2: VAR Lag Order Selection Criteria*

Sample: 1998M11 2016M10						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	4778.821	NA	3.97e-32	-46.76295	-46.61656	-46.70373
1	5834.203	2007.295	2.82e-36	-56.31571	-54.85184	-55.72355
2	6052.035	395.0889	7.41e-37	-57.65721	-54.87584*	-56.53210*
3	6125.299	126.4155	8.08e-37	-57.58136	-53.48251	-55.92330
4	6188.857	104.0614	9.79e-37	-57.41037	-51.99402	-55.21936
5	6315.079	195.5197	6.50e-37*	-57.85372	-51.11988	-55.12976
6	6380.654	95.79086	7.97e-37	-57.70249	-49.65117	-54.44558
7	6459.908	108.7794	8.73e-37	-57.68537	-48.31656	-53.89551

8	6550.938	116.9111	8.75e-37	-57.78370	-47.09740	-53.46090
9	6617.598	79.73053	1.15e-36	-57.64311	-45.63933	-52.78736
10	6699.719	90.97797	1.36e-36	-57.65411	-44.33283	-52.26541
11	6814.873	117.4118	1.21e-36	-57.98895	-43.35019	-52.06731
12	6926.252	103.7356*	1.20e-36	-58.28679*	-42.33053	-51.83219

\* indicates lag order selected by the criterion

To estimate parameters of SVAR in this study, the lag-length of the reduced form should be determined. Table 2 shows the results of different lag-length criteria. There are two criteria suggesting two lags, namely SC and HQ. Two other criteria, LR and AIC suggests 12 lags. Due to limited data, the most parsimonious model should be chosen to reduce the number of estimated parameters (Ouliaris et al., 2016). Therefore, 2 lags (2 months) is selected. Moreover, the eigenvalues of VAR (2) model presented in Table 3 all lie inside the unit circle, so the VAR/SVAR models with two lags satisfy the stability condition and can be estimated.

*Table 3: VAR Stability*

Roots of Characteristic Polynomial  
Endogenous variables: DLOIL DLRICE FED DLGDP  
DLCPI DLM1 PR DLCRE DLNEER  
Exogenous variables: C  
Lag specification: 1 2

Root	Modulus
0.974887	0.974887
0.893432 - 0.055329i	0.895144
0.893432 + 0.055329i	0.895144
0.574901 + 0.617924i	0.844003
0.574901 - 0.617924i	0.844003
0.668103	0.668103
0.521374	0.521374
-0.443379	0.443379
0.084791 + 0.420935i	0.429390
0.084791 - 0.420935i	0.429390
0.325547 + 0.220592i	0.393245
0.325547 - 0.220592i	0.393245
-0.189586 - 0.315687i	0.368240
-0.189586 + 0.315687i	0.368240
0.083065 + 0.257067i	0.270154
0.083065 - 0.257067i	0.270154
-0.228161	0.228161
-0.177444	0.177444

No root lies outside the unit circle.  
VAR satisfies the stability condition.

Table 4 shows the results of Johansen's co-integration tests for variables in levels form. The results imply that there is co-integration at rank two. This is reasonable because co-integration commonly exists between variables such as GDP and credit (IMF, 2017). Furthermore, the results of Johansen's co-integration tests in first difference forms indicate that there is no evidence of co-integration (Table 5).

*Table 4: Johansen's co-integration tests in levels form*

Sample (adjusted): 1998M12 2016M10  
Trend assumption: Linear deterministic trend  
Series: LCPI LCRE LGDP LM1 LNEER LOIL LRICE PR FED  
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.338502	282.1234	197.3709	0.0000
At most 1	0.250802	193.2750	159.5297	0.0002
At most 2	0.184410	131.1934	125.6154	0.0219
At most 3	0.139426	87.36711	95.75366	0.1641
At most 4	0.102018	55.08377	69.81889	0.4155
At most 5	0.080966	31.94869	47.85613	0.6150
At most 6	0.040420	13.79569	29.79707	0.8519
At most 7	0.021830	4.924837	15.49471	0.8167
At most 8	0.000834	0.179432	3.841466	0.6719

*Table 5: Johansen's co-integration tests in first difference forms*

Sample (adjusted): 1999M02 2006M12  
Included observations: 95 after adjustments  
Trend assumption: Linear deterministic trend  
Series: DLCPI DLCRE DLGDP DLM1 DLNEER DLOIL DLRICE FED PR  
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.716295	439.7941	197.3709	0.0000
At most 1	0.686424	320.1111	159.5297	0.0000
At most 2	0.513647	209.9383	125.6154	0.0000
At most 3	0.361683	141.4604	95.75366	0.0000
At most 4	0.290556	98.81303	69.81889	0.0001
At most 5	0.249249	66.20199	47.85613	0.0004
At most 6	0.185508	38.96732	29.79707	0.0034
At most 7	0.163728	19.47415	15.49471	0.0119
At most 8	0.025850	2.488025	3.841466	0.1147

### 6.3. Estimations of contemporaneous coefficient matrix

Table 6: Contemporaneous coefficient matrix for period 1998-2006

	OIL	RICE	FED	GDP	CPI	M1	PR	CRE	NEER
OIL	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
RICE	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FED	-0.0040 0.0021	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GDP	-0.0020 0.0026	0.0169 0.0058	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CPI	-0.0112 0.0050	-0.0328 0.0116	0.0000	0.3275 0.1952	1.0000	0.0000	0.0000	0.0000	0.0000
M1	0.0000	0.0000	0.0000	-1.5137 1.2811	-0.1903 0.6359	1.0000	0.5591 0.5011	0.0000	0.0000
PR	0.0000	0.0000	0.2412 0.3186	-0.3545 0.2578	0.1133 0.1287	0.0000	1.0000	0.0000	0.0000
CRE	0.0000	0.0000	0.0000	0.0000	-0.3916 0.3409	-0.4276 0.0542	0.4974 0.2668	1.0000	-0.1810 0.1512
NEER	0.0010 0.0114	-0.0054 0.0265	-2.0648 0.5322	-0.5406 0.4430	0.4737 0.2256	0.0089 0.0339	0.0317 0.1681	0.0000	1.0000

Table 7: Contemporaneous coefficient matrix for period 2007-2016

	OIL	RICE	FED	GDP	CPI	M1	PR	CRE	NEER
OIL	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
RICE	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FED	-0.0029 0.0012	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GDP	-0.0062 0.0051	0.0041 0.0080	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CPI	-0.0169 0.0048	-0.0108 0.0073	0.0000	-0.0801 0.0846	1.0000	0.0000	0.0000	0.0000	0.0000
M1	0.0000	0.0000	0.0000	-0.8196 0.4861	0.8834 0.4985	1.0000	1.1851 0.3741	0.0000	0.0000
PR	0.0000	0.0000	-0.6103 0.5124	-0.0839 0.1187	-0.0445 0.1221	0.0000	1.0000	0.0000	0.0000
CRE	0.0000	0.0000	0.0000	0.0000	-0.0195 0.1311	-0.2663 0.0238	0.1161 0.1078	1.0000	-0.0905 0.0758
NEER	0.0012 0.0092	-0.0060 0.0133	-0.7145 0.6753	-0.1923 0.1548	-0.0680 0.1676	-0.0064 0.0288	-0.4615 0.1228	0.0000	1.0000

\*blue cells denote that the coefficient is significant at 5 percent significance level.

\*green cells denote that the coefficient is significant at 5 percent significance level.

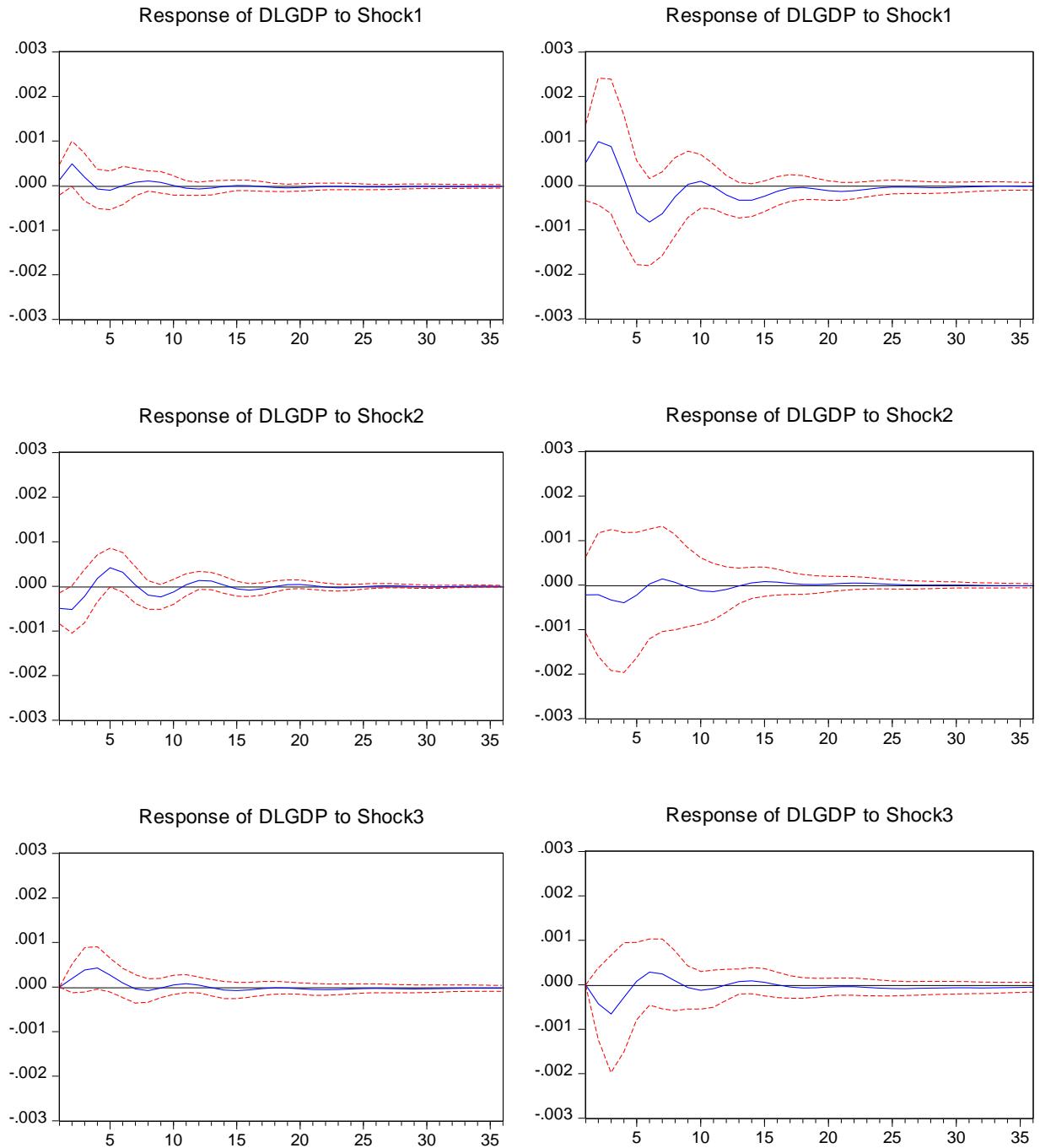
The two matrixes illustrate some interesting points. The effects of world rice price on GDP and CPI became insignificant in 2007-2016. The impact of GDP on CPI was more noticeable in the first period than in the second. However, M1 seemed to be more responsive to shocks from GDP and CPI in the later period than in the preceding one. The impact of PR on CRE was fading in 2007-2016. Finally, NEER responded to shocks from FED and CPI in 1998-2006 while in 2007-2016, it only reacted to shocks from PR.

## 6.4. Response of domestic variables to shocks

### 6.4.1. Responses of GDP and CPI to foreign shocks

#### 6.4.1.1. Responses of GDP to foreign shocks

Figure 5: Responses of GDP to foreign shocks, 1998-2006 and 2007-2016



According to Figure 5, in 1998-2006, positive innovations to oil price caused a positive impact on GDP. The effect of oil shocks seemed to dwindle after one year and is not significant in the long term. An increase in output here is reasonable. Before 2007, Vietnam had to import the final products of oil as the first oil refinery only started to operate in 2010. However, the exporting value crude oil was substantively larger than importing value of final products. The differences were 1,432 million USD in 2000 and 2,092 million USD in 2006 (WITS, 2017). Therefore, an increase in oil price would increase GDP.

In 2007-2016, responses of GDP to shocks from oil price seemed to be stronger, and the impact of oil price lasted for approximately two years. An increase in world oil price led to a positive response of GDP in the first four and half months. However, after this period, this increase seemed to exert a negative impact on GDP. The stronger responses of GDP could be explained by the WTO accession in 2007. Because Vietnamese economy was more open, it would become more responsive to major external shocks such as oil. Positive responses of GDP in the first period resulted from the revenue that Vietnam gained as an exporter of crude oil. Negative responses of GDP latter could be explained by the rising cost of production due to an increase in oil price. One should note that before 2007, domestic petroleum price was heavily regulated by the government and stayed below the world price (IMF, 2006). Therefore, an increase in world oil price in 1998-2006 would have an insignificant impact on the cost of production. Thus, one cannot see the negative responses of GDP latter to shocks from oil price in 1998-2006 as GDP does in 2007-2016.

An increase in world rice price led to a negative response of GDP, then a positive and negative again in 1998-2007. The effect lasted for around one and a half year. According to Bui and Karla (2016), the correlation between food inflation and world rice price in Vietnam is extremely strong. Therefore, an increase in world rice price indicated that food price in Vietnam could also increase, and total consumption might fall due to a decrease in budget and cause GDP to fall. However, because Vietnam is one of the largest exporters of rice, after several months, an increase in rice price would bring a positive impact on exported rice and lead to positive responses from GDP.

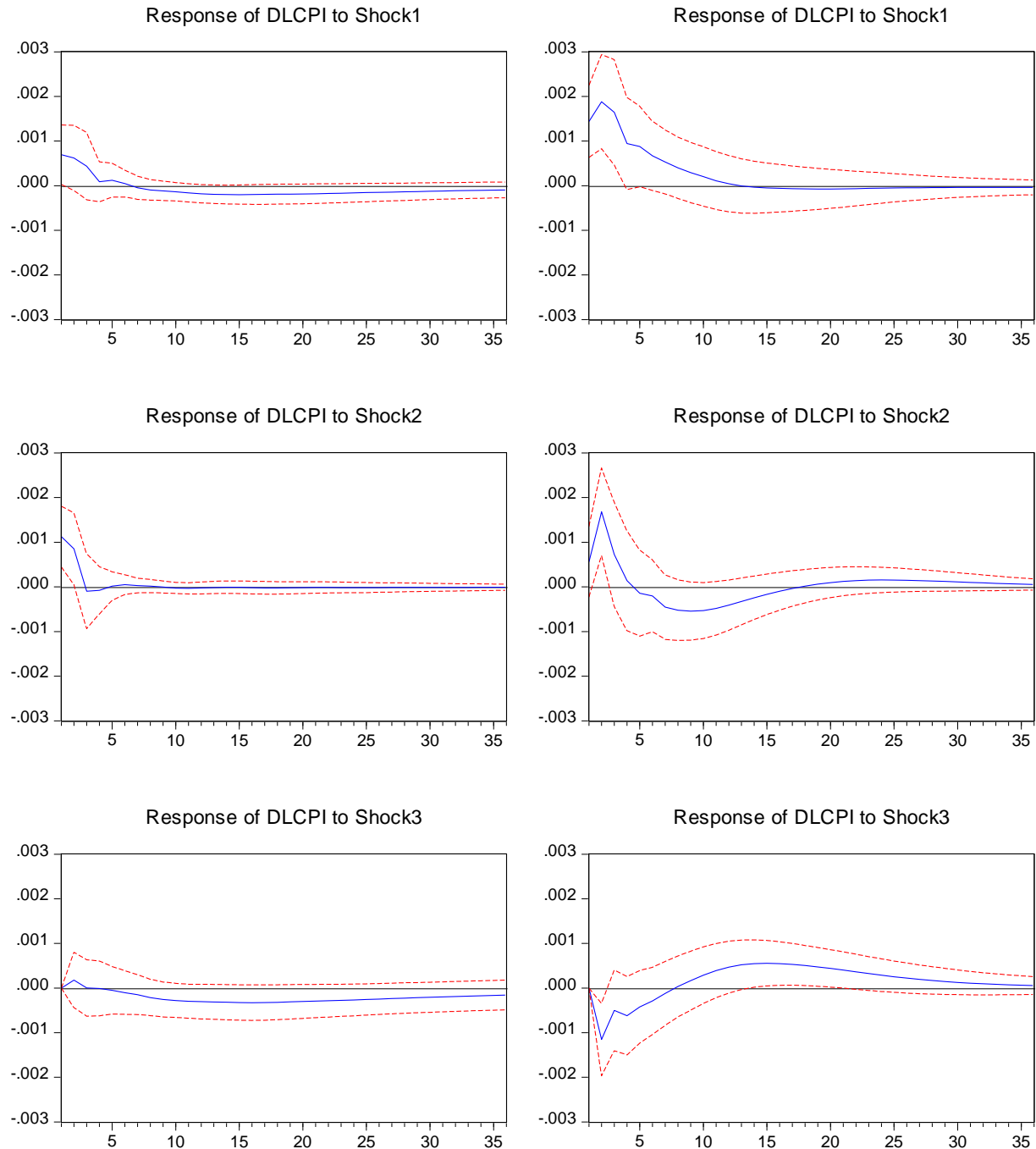


In 2007-2016, positive innovations from rice price led to negative responses of GDP. Similar to the previous period, the high correlation between food inflation and world rice price could be used to account for these responses. However, the effect of rice price was larger and longer in 1998-2006 than that in 2007-2016. This difference in two periods was consistent with the structural change in Vietnamese economy in the 2000s. Before 2000, Vietnam still focused on developing agriculture, but after 2000, the priority became the development of industrial and service sectors (Ministry of Industry and Trade Vietnam, 2012). Moreover, when looking at the main exported goods of Vietnam, one can see that more high-value-added goods have become dominant while the percentage of the value of exported rice to the total exported goods decreased by years (Ministry of Industry and Trade Vietnam, 2017). Therefore, an increase in rice price could not affect output growth as it did in 1998-2006 because the increase in the value of exported price contributed significantly less to the value of total exported goods.

As shown in Figure 5, shocks from Federal Fund Rate had a positive impact on GDP in 1998-2006 but a negative impact in 2007-2016. The positive influence in the first period was quite understandable for a relatively close economy like Vietnam before 2007. Because an increase in the US interest rate benefited Vietnam's export, output might increase as a result. Moreover, examining the responses of domestic interest rate to an increase in FED, one can see that in 1996-2006, domestic interest rate, PR, seemed to have no response while in 2007-2016, PR responded positively overall to the increase. Therefore, it is reasonable to assume that after 2006, policymakers might need to react to an increase in FED by increasing domestic interest rate to avoid currency depreciation when the economy was more open. This increase in PR can discourage total demand and lead to a decrease in output. According to Kim and Roubini (2000), there is evidence that the effect of an increase in interest rate is bigger than the positive effect of export. Hence, this could also be the case for Vietnam.

#### 6.4.1.2. Responses of CPI to foreign shocks

Figure 6: Responses of CPI to foreign shocks, 1998-2006 and 2007-2016



For CPI, in both surveyed periods, an increase in oil price would lead to a positive response of CPI. The positive responses of price level to shocks from oil price were consistent with the predicted results of economic theories for a small economy like Vietnam because world oil price could affect domestic oil price in Vietnam. Moreover, the

magnitude and length of the impact of oil price on price level in the second period were significant and larger than that in the first period. This could be explained by the openness of Vietnamese economy. Before 2007, due to administrated prices, domestic petroleum price only increased nine times and remained below the world level (IMF, 2006). Therefore, world oil price only had a limited effect on price level before 2007.

The responses of CPI to shocks from rice price were well behaved in both periods, as an increase in rice price causes a positive impact on CPI, and this effect decreased over time. Compared two periods, one could also observe a greater magnitude and longer duration of the effect in 2007-2016. The openness of Vietnamese economy might also account for this difference.

In 1998-2006, an increase in FED seemed to have a negative impact on CPI, but the effect was negligible. One possible explanation is an increase in FED might be the response of Federal Reserve to a decrease in oil price, and a decrease in oil price might cause inflation to fall. Nevertheless, the insignificant of the impact implies that this is not a strong claim. However, in 2007-2016, positive innovations from FED rate possibly led to a negative response of CPI. In this period, an increase in FED is likely to follow by an increase in domestic interest rate, PR, and as PR increase, domestic demand might fall and lead to a decrease in inflation.

Generally, only the impact of world rice price on price level was significant in 1998-2006. While in 2007-2016, all three variables had a noticeable impact on price level. This illustrates the openness of Vietnamese economy and implies that policymakers should change their approach to control inflation after 2007.

## 6.4.2. Responses of GDP and CPI to domestic shocks

### 6.4.2.1. Responses of GDP to domestic shocks

Figure 7: Responses of GDP to domestic shocks, 1998-2006

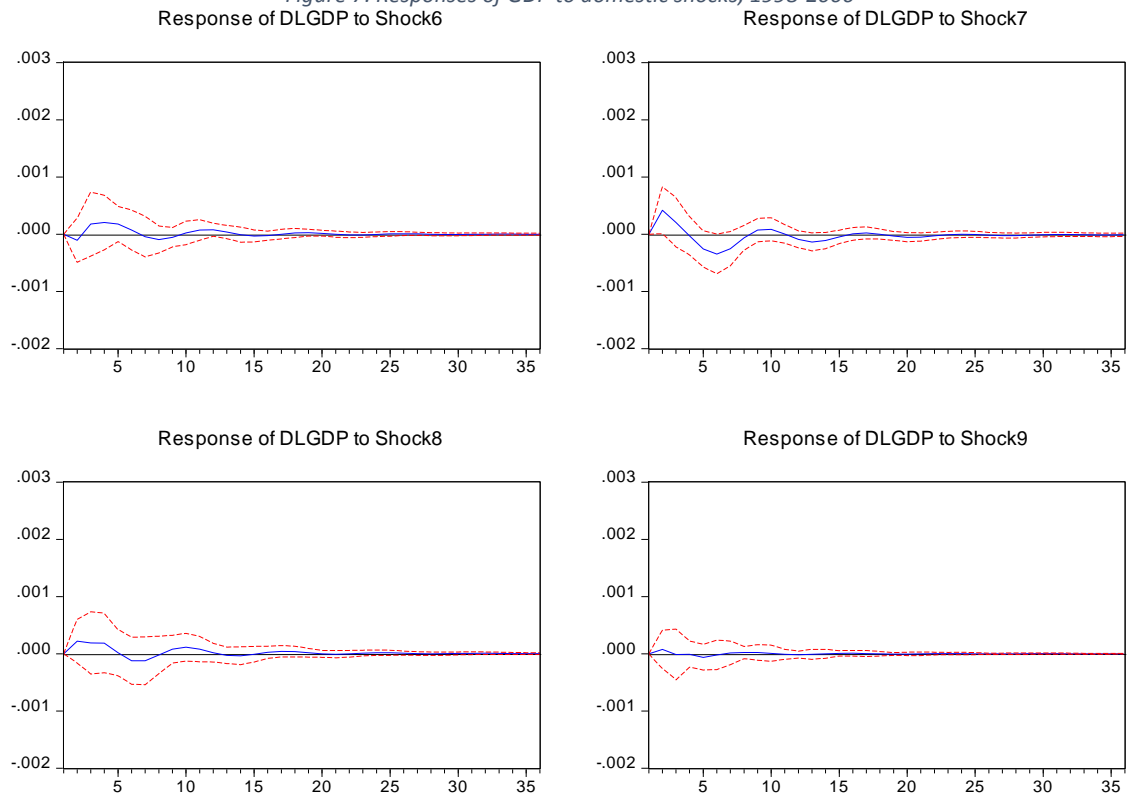
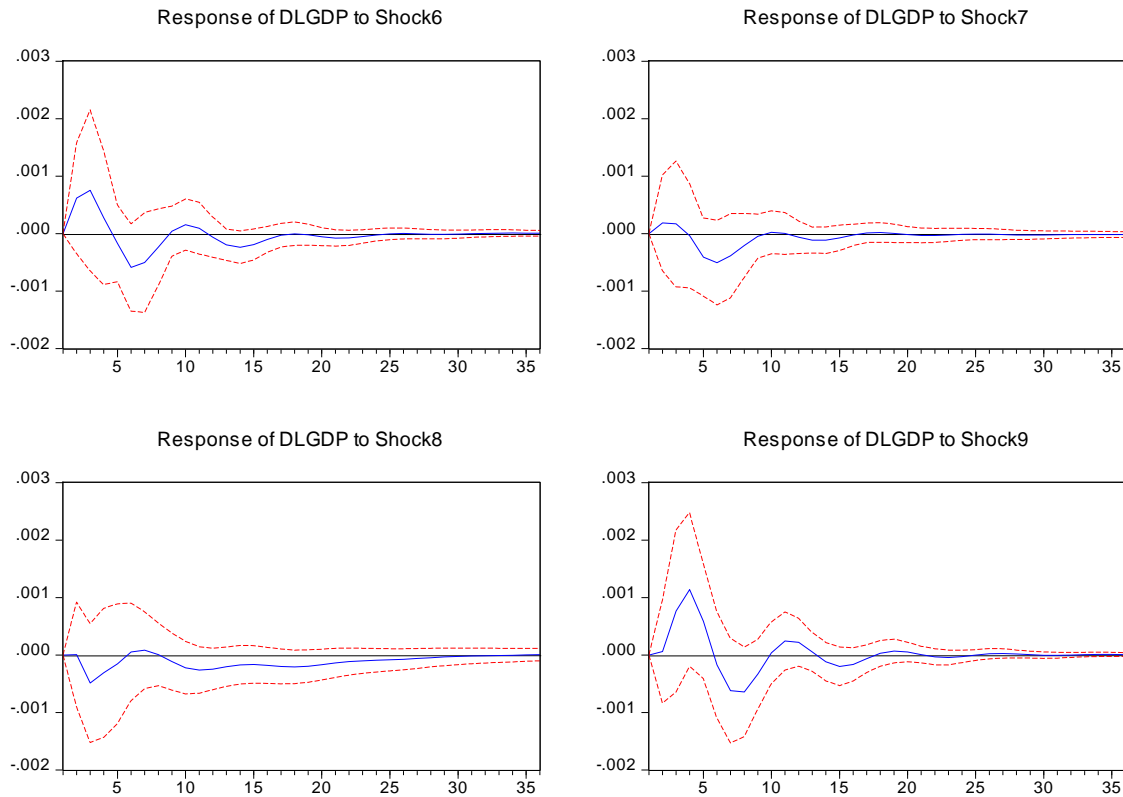


Figure 8: Responses of GDP to domestic shocks, 2007-2016



For 1998-2006, among all the responses to positive innovations from domestic shocks, responses of GDP to shocks from policy rate were the largest as illustrated in the figure above. In details, positive innovations from policy rate could create an increase in output level and this growth maintained for three months before declining for another five months, then fluctuated and completely vanished after 16 months. The first increase of output in response to an increase in policy rate seems to be contradictory to the predicted response of theoretical models, as output should decrease with an increase in interest rate. One possible explanation is there exists a delay from the time the policy is implemented to the time it actually creates an impact, and one can see that there is a decrease in output followed after.

Secondly, shocks from M1 first seemed to cause a positive impact on GDP overall with a slightly negative response in the first two months. This phenomenon is consistent with the normal reaction of policy makers, as they notice a recession might happen, money would be injected into the economy to boost investment and consumption, and due to a delaying time that the policy needs to create an impact on the economy, output would decrease

for the first few months, and then increase after that. However, the effect was comparatively small and might not be significant.

Thirdly, GDP seemed to have a positive response to shocks from CRE for five months and then a negative response for four months. However, the large confidence interval including zero gave no conclusion about the impact of CRE on GDP. Moreover, based on Figure 7, GDP might not respond to positive innovations of NEER.

In the second period, GDP appeared to be more responsive to shocks from M1, CRE, and NEER while the magnitude and length of impact of PR remained unchanged.

Overall, positive innovations of PR, led to a decrease in GDP as predicted by economic theories when an increase in interest rate reduce total demand and lead to a fall in output. However, this impact might be temporary and disappear after one year.

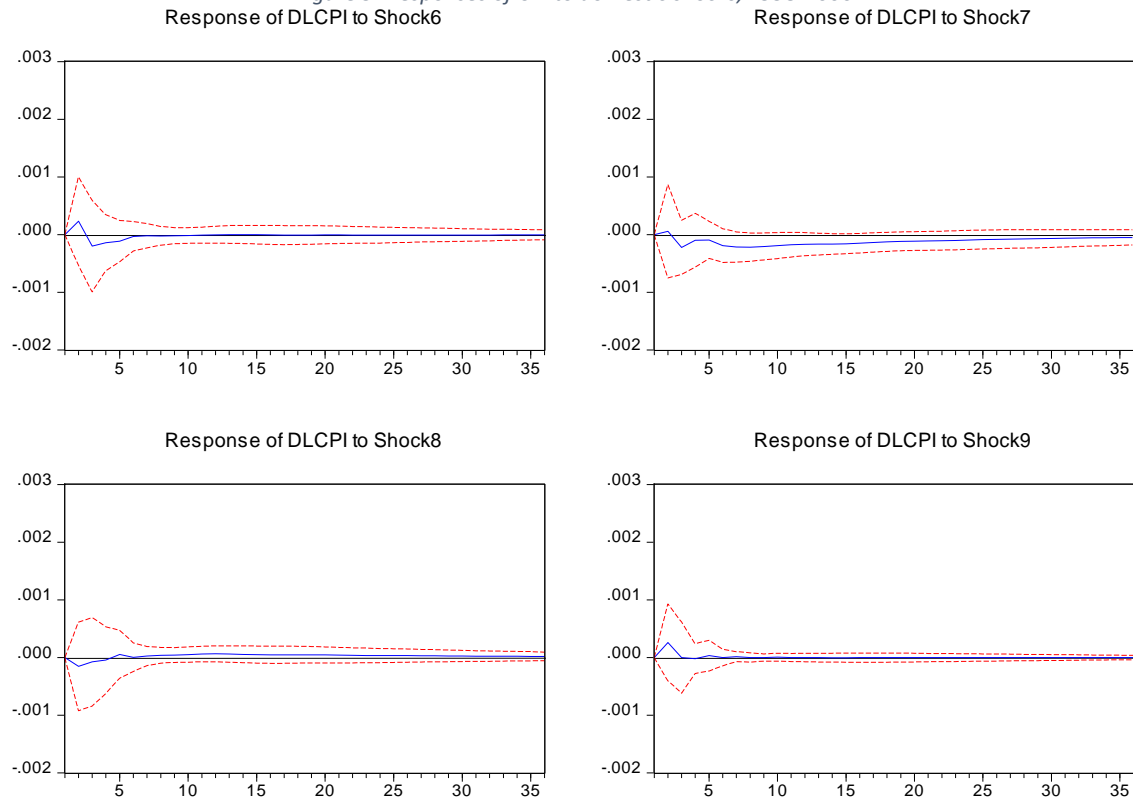
Shocks from M1 might create a positive impact on GDP for four months then a negative one for five months, and continued to exert fluctuated impacts. However, as shown in Figure 8, the impact might not be noticeable.

Considering the impact of NEER on GDP, it is likely that GDP responded positively to shocks from NEER. In other words, a devaluation of VND in 2007-2016 can have a positive impact on GDP. However, similar to M1, the large confidence interval including zero over the estimated time implies an insignificant influence of NEER.

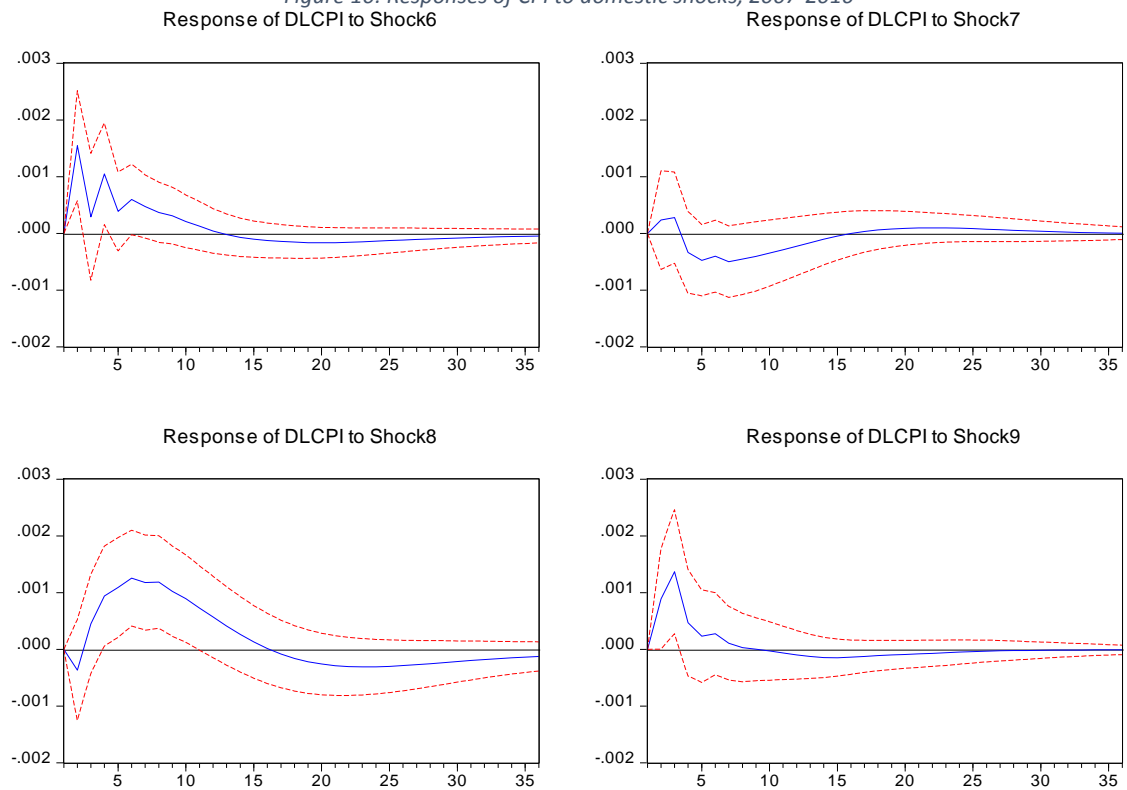
Finally, due to the large confidence interval of all domestic variables, one cannot reject the hypothesis that GDP has no response to these variables and cannot infer a significant impact of the domestic variable on GDP.

### 6.4.2.2. Responses of CPI to domestic shocks

*Figure 9: Responses of CPI to domestic shocks, 1998-2006*



*Figure 10: Responses of CPI to domestic shocks, 2007-2016*



In 1998-2006, the responses of CPI to shocks from M1 is positive in the first month, then negative for the next five months, and then diminished. It is likely that an increase in M1 creates a slight increase in inflation, but the increase would be negligible according to Figure 9. Positive shocks from M1 will lead to a positive response of CPI because as money supply increases in the short run while output is likely to remain unchanged, price level will increase relatively to counter the effect of excess money.

An increase in PR might result in a decrease in inflation in this period, but the impact is temporary and unnoticeable. The responses of CPI follow economic theories, as the interest rate increases, aggregate demand falls and leads to the reduction of inflationary pressure.

Shocks from CRE exerted a slightly negative impact on CPI, but the duration of the effect was only approximately five months. The weak response of CPI to M1 and CRE might suggest that credit channel was not the major instrument that SBV used to control inflation in this period.

The response of CPI to positive innovations from NEER was positive and lasted for 3 months. Particularly, a devaluation of VND led to a slightly increase in inflation. One possible explanation for this phenomenon is devaluations of domestic currency will result in more expensive imported goods, and this increase in price translate into a higher price level overall. Moreover, devaluations also encourage the demand for exported goods, and lead to an increase in output and can lead to higher inflation.

Nevertheless, there are some changes in responses of CPI to shocks from domestic variables in 2007-2016. The effect of all variables become more significant.

An increase in money supply, M1, had a positive impact on price level, and this impact lasted for around one year before dwindling. Similar to the previous period, the effect of M1 is consistent with economic theories. However, the significance of the impact might imply that money supply can be one of the main sources of inflation after 2007.

Responses of CPI to an increase in PR were slightly positive for the first three months and then significantly negative for the next 14 months after completely disappearing. While the negative responses can be explained by economic theories as above, the



presence of a slightly positive response suggests that there might be a price puzzle here. This puzzle indicates that SBV might not use interest rate policy effectively to control inflation, or this policy is not the major tool of SBV to manage inflation.

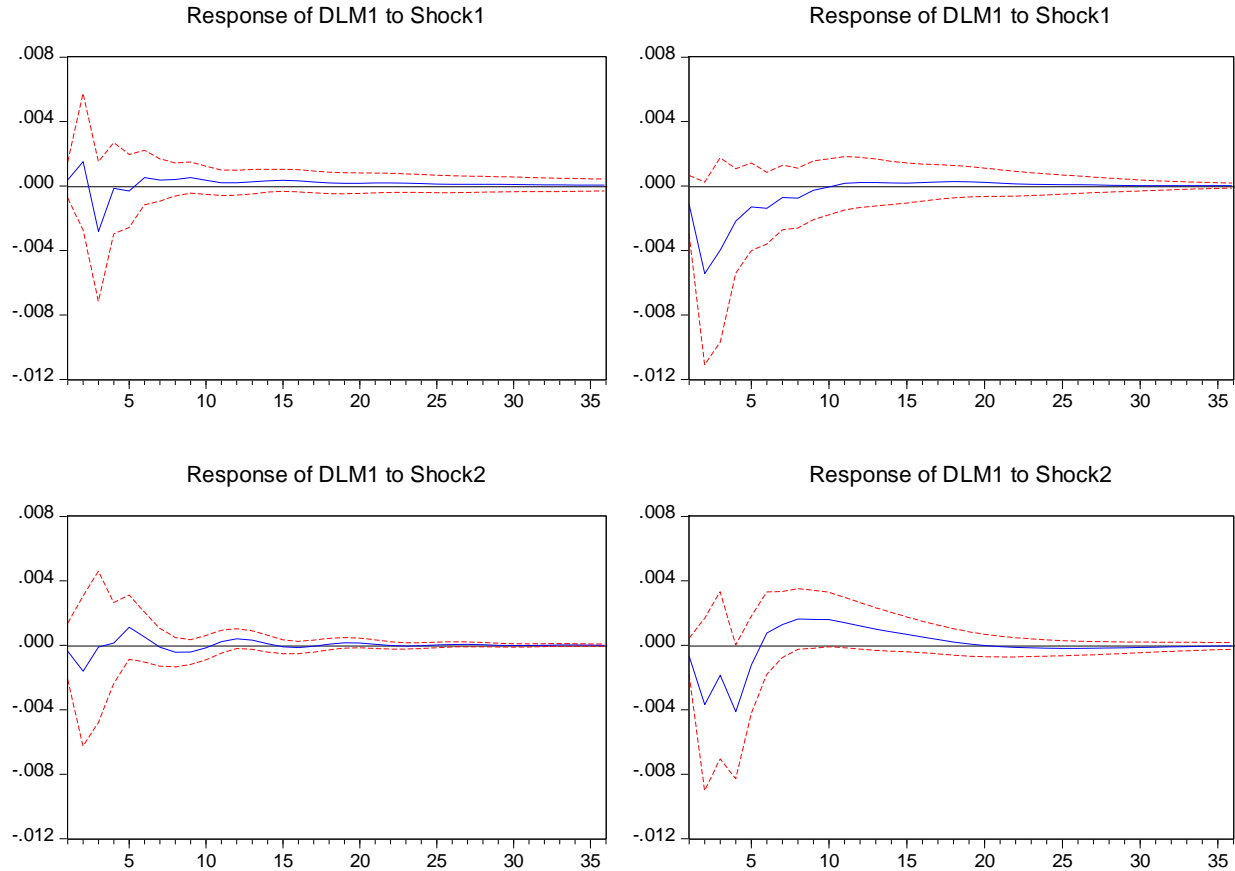
As illustrated in Figure 10, shocks from CRE exerts a significantly positive impact on CPI. In explanation, an increase in domestic credit aggregate means that it can be easier to borrow and boost investment, which leads to an increase in output and translate into higher inflation. The significance of impact shows that the credit channel might be an important one in monetary transmission mechanism for SBV.

Similarly, shocks from NEER led to significantly positive responses of CPI for eight months. Explanations for these positive responses resemble those in the previous period.

Lastly, among four variables, the responses of CPI to shocks from M1, CRE, and NEER seemed to be significant in 2007-2016 while those to shocks from PR might not be significant. Therefore, credit channel and exchange rate channel can be more important to transmit the effect of monetary policy than interest rate channel in this period. However, the responses of CPI to shocks from M1, PR, CRE, and NEER give no conclusion about the importance of three channels, since they all seems to be insignificant.

### 6.4.3. Responses of monetary shocks to foreign shocks

Figure 11: Responses of M1 to foreign shocks, 1998-2006 and 2007-2016

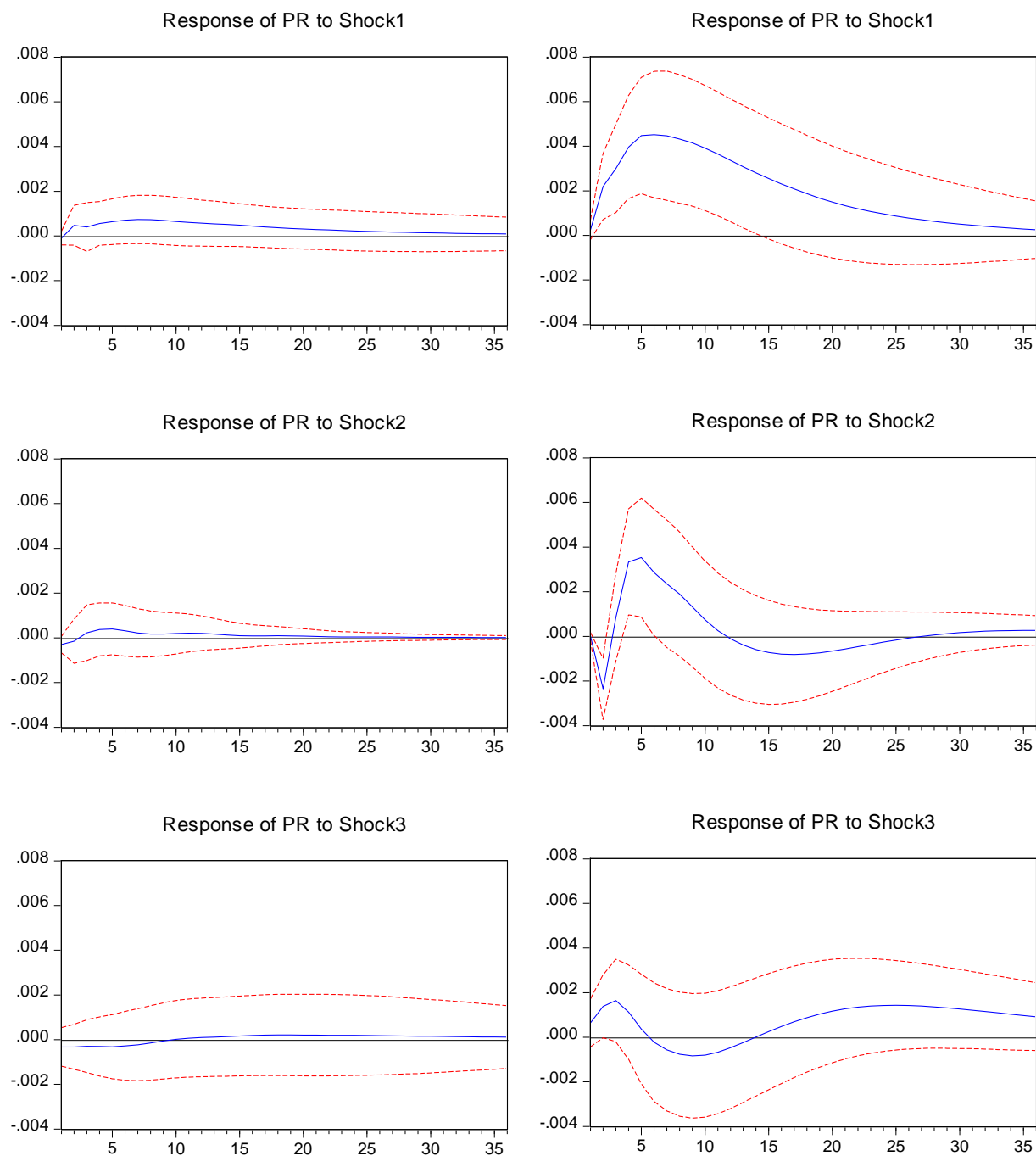


In 1998-2006, shocks from oil price had a slightly positive impact on M1 for two months and then turned negative for the next three months. While shocks from rice price exerted a negative impact on M1 for around four months, and then a positive impact on the next four months. However, the responses of M1 to foreign shocks is not statistically significant as implied by the confidence interval.

In 2007-2016, both shocks from oil price and rice price lead to negative responses of M1 first. The duration of negative impact of oil and rice price were one year and six months respectively. Later, the impact of oil diminished while the impact of rice price turned positive and last for 18 months. A negative response in money aggregate implies that SBV might conduct a contractionary monetary policy after noticing an increase in oil price and rice price, which can lead to higher inflation. Positive responses to rice price later might suggest that rice price is not a major concern of SBV to design and implement its

monetary policy in this period. Furthermore, there might exist a change in the magnitude of both impacts on M1, which suggest that SBV has paid more attention to deal with the external inflationary factors after 2007.

*Figure 12: Responses of PR to foreign shocks, 1998-2006 and 2007-2016*

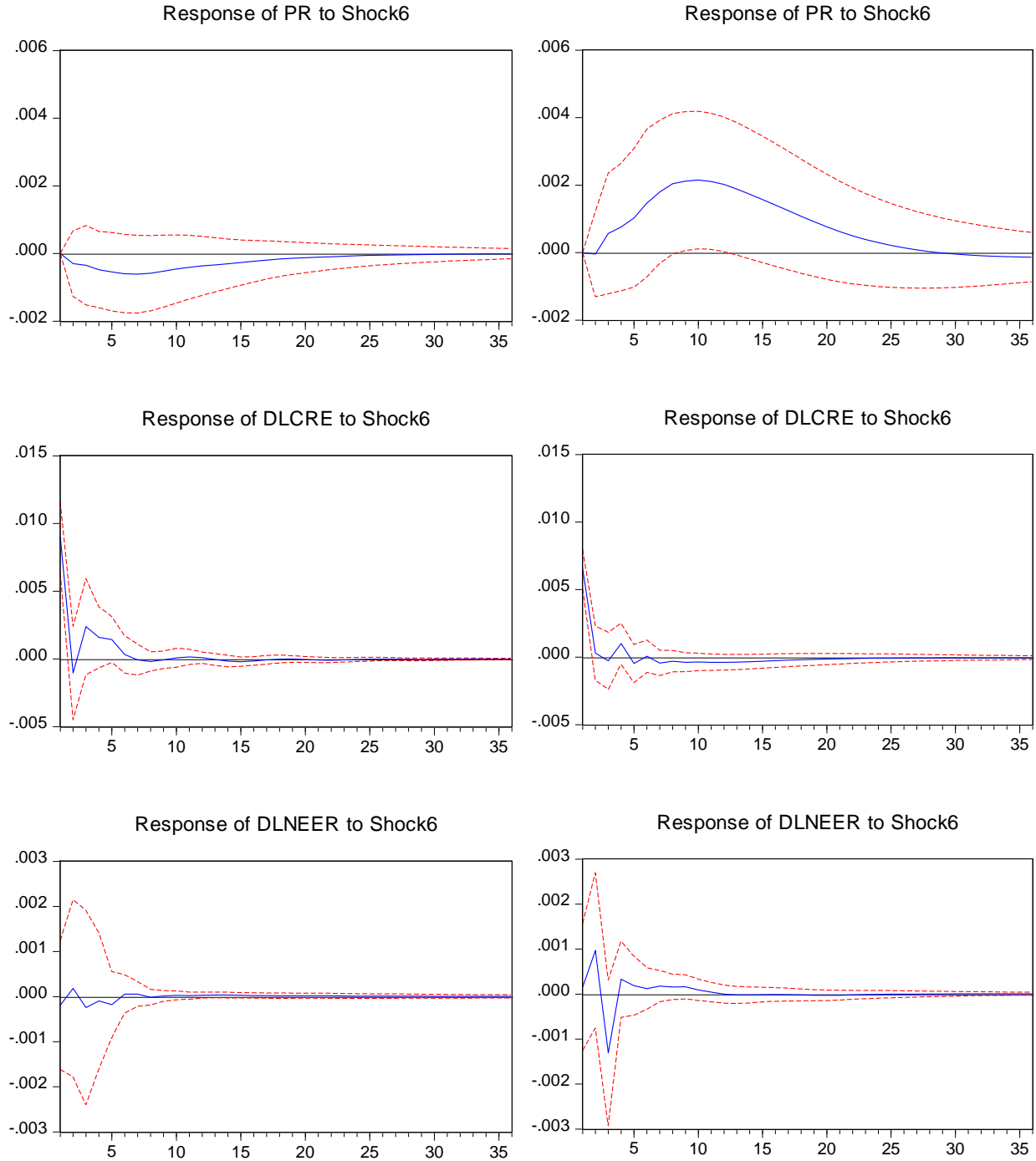


In Figure 12, there is a noticeable difference between the responses of PR to external shocks. For 1998-2006, foreign factors might have no impact on PR. However, from 2007 to 2016, an increase in oil price led to an increase in interest rate PR. An increase in rice price first led to a slightly decrease in interest rate but then a noticeable increase in interest rate after three months. The positive responses of PR to oil and rice price's shocks suggest that policymakers in Vietnam have implemented a contractionary monetary policy to counter the inflationary pressure. However, the abnormal behavior in response to rice price at first indicates that policy maker might not place a considerable attention to changes in rice price to adjust monetary policy. In addition, an increase in FED also exerts a positive impact on PR, overall. This phenomenon can be explained by the fact that as foreign interest rate increases, a devaluation of domestic currency can happen because foreign currency is now more expensive. To prevent devaluations, the central bank might raise the domestic interest rate, and thus, increase the value of domestic currency.

At last, the structural change in the responses of interest rate to foreign factors confirms that SBV might be more active in mitigating the effect of external shocks to inflation in Vietnam.

#### 6.4.4. Responses of monetary shocks to monetary shocks

Figure 13: Responses of domestic variables to M1 shocks, 1998-2006 and 2007-2016



According to economic theories, if M1 increases- ceteris paribus- it is expected that interest rate would decrease because when more money is available in the market, the cost of borrowing, interest rate, will be lower. The reaction of interest rate, PR, in 1998-2006 followed this statement. In details, positive innovations of M1 seemed to have a

negative impact on PR, and this impact was likely to last for approximately two years after completely dwindling. However, in the second period, in response to an increase in M1, PR decreased instead of increasing. This liquidity puzzle might result from an attempt by policy makers to avoid an increase in price level due to an increase in money supply, which might be an outcome of other policies such as fiscal policy. Moreover, it is worth to note that during this period, there was a large capital inflow due to WTO accession in 2007 (Pham, 2017). Finally, an increase in the magnitude of responses in 2007-2016 might be an evidence for the rising role of interest rate channel in monetary transmission mechanism, but this is not a strong finding due to the large confidence interval covers zero.

As shown in Figure 13, an increase in M1 would lead to a positive response of CRE in both periods. Moreover, the significance of the impact in 1998-2006 was greater than that in 2007-2016. However, the duration of the impact on CRE seemed to be longer in the second period, which was around one and a half year in comparison with that in the first – approximately seven months. These differences in two periods certified the importance of money aggregate for SBV to manage the credit supply. The significant positive responses of CRE in two periods, as illustrated by the confidence interval, indicated that credit channel was an important channel for transmitting the effect of monetary policy to the economy. Nevertheless, the smaller magnitude of responses in the second period implied that the role of this channel in monetary transmission mechanism in the later period has reduced.

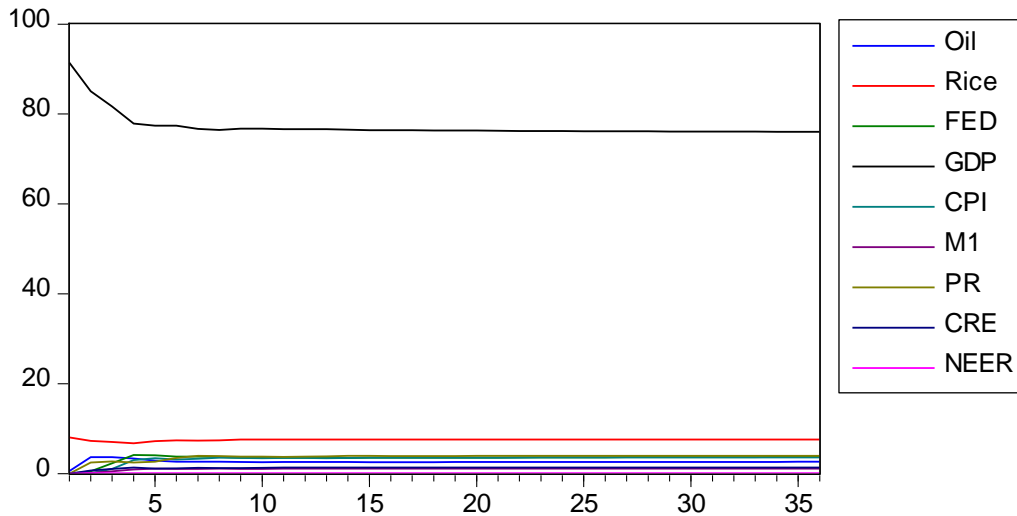
For NEER, in the first period, shocks from M1 had a negative impact on NEER first, but quickly turned to positive in less than one month, became negative after one month, and lasted for more than four months before fading. However, an increase in M1 had a positive influence in NEER that remained for one and a half month, then a negative influence for more than one months, and a positive one before disappearing in the eleventh month. There are several explanations for the inconsistent behaviors of NEER in two periods. Besides money supply, other sources such as dollarization, black market, and interventions other than monetary policy by the central bank can lead to change in the exchange rate (Pham, 2016). For Vietnam, it is likely that dollarization

and intervention are important factors to explain the phenomenon. In details, an increase in money supply should lead to a depreciation of the domestic currency due to its increasing quantity in the market, and this is consistent with the positive responses of NEER. However, with the presence of dollarization at 30% (Nguyen, 2012), a fixed amount of USD might remain in the economy despite the movements of VND/USD, so money supply cannot have the desired effect on NEER.

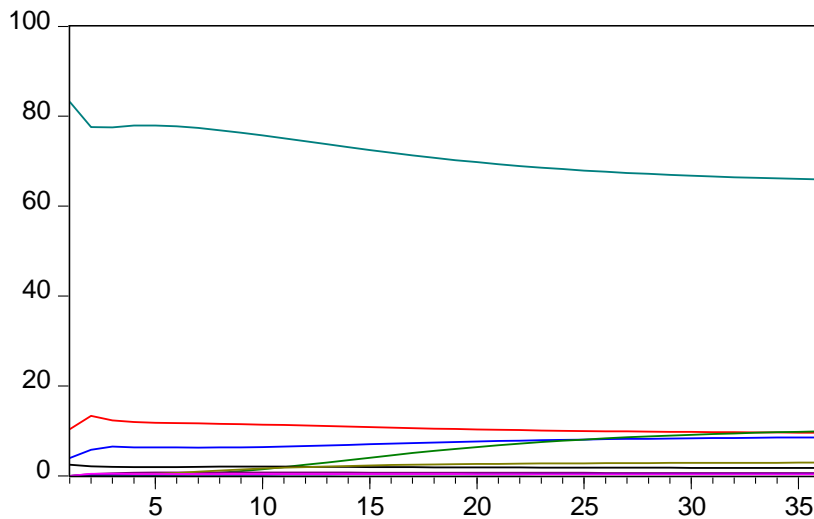
Finally, except for CRE, because the confidence intervals of PR and CRE in both periods contain zero along the estimated horizon, arguments presented in these parts cannot be claimed to be significant findings.

## 6.5. Variance decomposition of GDP and CPI

Figure 14: Variance decomposition of GDP and CPI, 1998-2006  
Variance Decomposition of DLGDP



Variance Decomposition of DLCPI



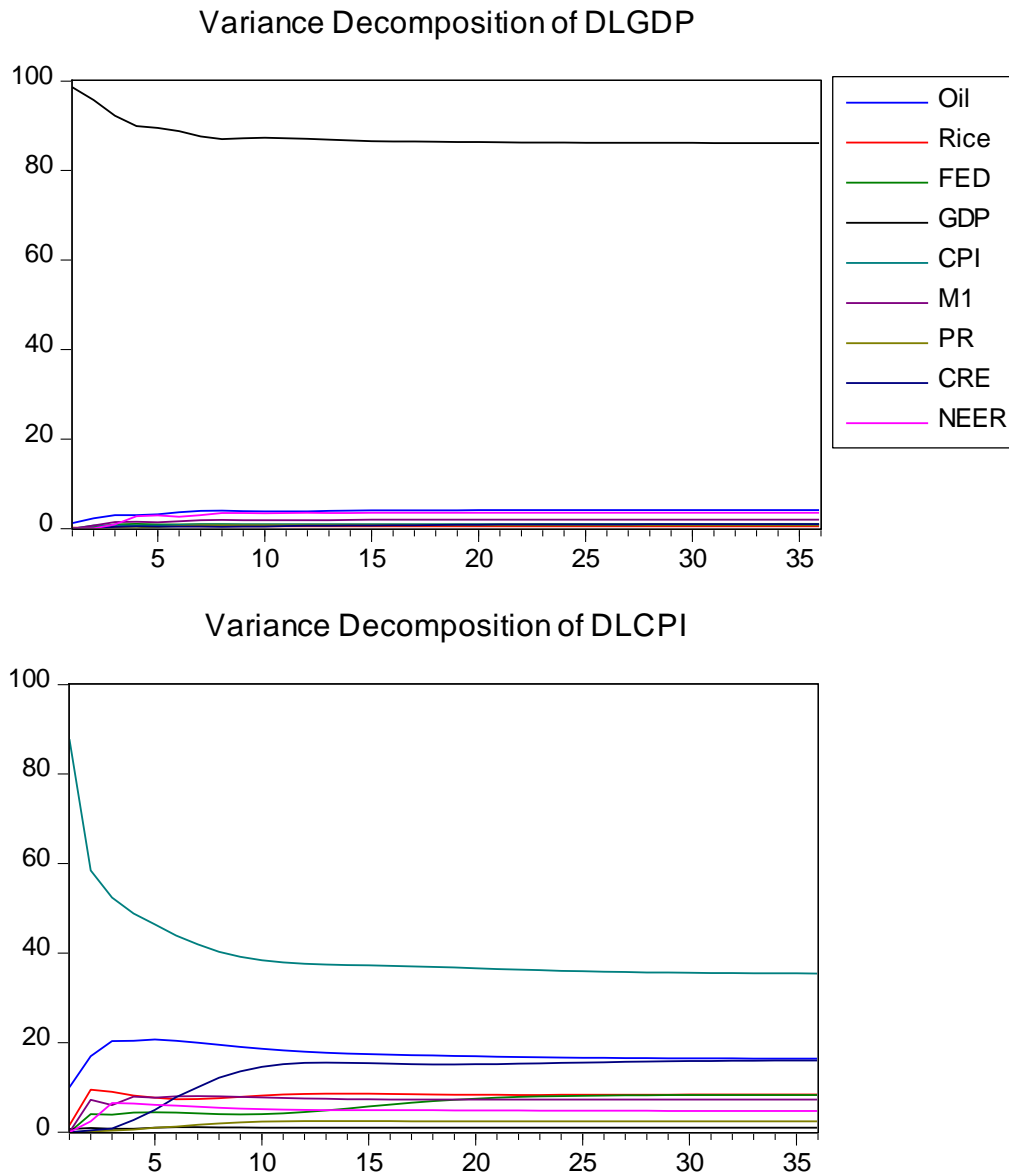
As shown in the figure above, in 1998-2000, GDP and CPI was the main elements that contributed to their variance. The contribution of GDP to its own variance decreased significantly from 90% to less than 80% in four months and then remained unchanged as the time horizon increased. However, the contribution of CPI to its own variance decreased over the time horizon of three years and reached 70% in the end.



In this period, one can see that the second largest source of variation in GDP and CPI was rice price with approximately 10% of GDP and 15% of CPI. This result is consistent with the fact that rice is a main exportable good and a primary commodity in Vietnam.

However, while the remaining factors contributed insignificantly to variation in GDP, as the time horizon increased, world oil price and Federal fund rate became more important in explaining for the error variance of CPI. Especially, at the end, the contribution of world oil price and Federal fund rate are almost identical to that of rice price. This result suggests that despite the relatively closeness of Vietnamese economy, external factors can still be the main source of price level fluctuations in the long term.

Figure 15: Variance decomposition of GDP and CPI, 2007-2016



From 2007 to 2016, GDP and CPI were also the main factors that account for their variation. The contribution of GDP to its own variance is 100% and decreased to less than 90% in five months. At the start, CPI explained about more than 80% of its own variation, but after 10 months, this number reduced to less than 40%.

While it is obvious that all other variables except GDP only had a negligible contribution to GDP variance, other variables could account for most of the CPI variance. The second largest source was world oil price, and the third source was domestic credit aggregate. Moreover, external shocks explained a large proportion of CPI variance with more than

30% after two months. Monetary policy shocks also accounted for approximately 30% of CPI variance in total, but their contributions were slightly smaller than those of external shocks were.

## **6.6. Main findings**

In general, these are the key findings of the analysis:

- GDP was more responsive to foreign shocks in 2007-2016 than in 1998-2006, but the significance of responses was inconclusive.
- Only the impact of world rice price on price level in Vietnam was statistically significant in 1998-2006, while the impacts of all world oil price, world rice price, and Federal Fund Rate were significant in the later period.
- The magnitude and length of the responses of GDP to shocks from monetary policy seemed to be larger in 2007-2016 than in 1998-2006. However, there is no statistical evidence of significant responses in two periods.
- In 1998-2006, credit channel might not be the primary tool to control inflation, and in 2007-2016, credit channel and exchange rate channel had an important role for transmitting the effects of monetary policy. The central bank might not use the interest rate channel to manage inflation effectively in 2007-2016, or this is not an important instrument of SBV. Moreover, money supply could be the source of inflation after 2007.
- External shocks seemed to have no impact on interest rate in 1998-2006. SBV might be more active in counter the inflationary pressure from external sources using money supply and interest rate in 2007-2016.
- The credit channel is a major channel in transmitting the effect of monetary policy, but the importance of credit channel has reduced after 2007. The role of interest rate channel might be larger in 2007-2016 than in 1998-2006, but there is insufficient evidence

that this is a major channel. Similar, no conclusion about the importance of exchange rate channel can be reached.

- In both periods, the main contributors of variation in GDP and CPI were their own shocks.

- In 1998-2006, the second largest source of GDI and CPI variance were world rice price. External shocks could still account for a significant proportion of variation in CPI in the long term (at the end of three years).

- In 2007-2016, all other variables except GDP had an insignificant contribution to GDP variance. The main sources of CPI variance were world oil price and domestic credit aggregate. In total, external factors explained more than 30% of CPI variance when monetary policy shocks explained slightly less, approximately 30%.

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## **7. DISCUSSIONS**

This section deals with the last research question: 'What is the implications for monetary policy in Vietnam?'. Firstly, a discussion about different channels of monetary transmission mechanism will be presented with some information about the structure of Vietnamese economy and monetary policy. Secondly, a deep examination of the structural changes of Vietnamese economy after 2007 will be conducted. Thirdly, from the previous discussion, recommendations for monetary policy in Vietnam will be covered.

### **7.1. Channels of monetary transmission mechanism:**

Before 2007, empirical results showed that credit channel played an important role in monetary transmission mechanism. This is not a surprising finding. As discussed in section 2, restrictions on foreign exchange market and foreign currency transactions still existed in this period and led to limited capital inflows. Therefore, for an emerging and closed economy like Vietnam, it is easier for the central bank to control the liquidity of the economy through bank credit. The relative immature of securities and equity markets also contribute to the dominant role of credit channel. Furthermore, it is worth to note that five SOCBs had the largest market share in the banking sector, which facilitate the ability of SBV to inject money into the economy through lending to these banks.

Interest rate channel only had an insignificant role. Moreover, the linkage between domestic interest rate and Federal Fund Rate is comparatively weak in both periods. Although an immature financial market reduces the effectiveness of the interest rate channel to transmit effects of monetary policy (Camen, 2006), it was likely that SBV did not focus on and use interest rate policy as a primary component of monetary policy from 1998 to 2016. Another reason for this ineffectiveness is the dominance of SOCBs in the banking sector. Because SOEs is the major customers of SOCBs, it can be the case that these SOEs enjoy a more favorable interest rate (Pham, 2016).

### **7.2. Changes after 2007**

External factors had a larger impact on domestic factors, namely GDP and CPI. Especially, external factors were found to have a significant impact on price level as shown in the impulse response and variance decomposition results. The possibility that money supply could be the source of inflation after 2007 and the presence of price puzzle

can suggest the limited ability of SBV to use monetary policy to control inflation. However, it is worth to note that SBV has become more concerned towards inflationary pressure from external factors.

The higher contribution of monetary policy shocks to variation in CPI in 2007-2016 compared to that in 1998-2006 (approximately 30% to 5%), and the fact that domestic credit is the third biggest contributor can be evidence of the ineffectiveness of monetary policy. Moreover, according to Pham (2016), and Nguyen and Nguyen (2010), a large capital inflow after 2007 had not been successfully sterilized by SBV, and contributed to high inflation in 2007-2011. In addition, the rising role of the interbank transaction adds more complications to the situation as banks now can create new money when making loans and borrowing from each other with less dependence on money supply from the central bank (McLeay et al., 2014, and Pham, 2016). Therefore, in such a complicated environment, SBV needs to adopt new instruments and approaches to be able to reach its goals.

### **7.3. Recommendations for monetary policy**

#### **7.3.1. The goal of monetary policy**

The multi-objectives of monetary policy in Vietnam has received a lot of criticisms in literature (Mai, 2007, To et al. 2012, and Nguyen, 2014), and from the empirical results, one might see that price stability was not the primary goal of monetary policy in Vietnam. Moreover, there is a consensus that price stability should be the major objective of monetary policy (Bernanke, 2001, and Mai, 2007). Mai (2007) argues that setting price stability as the primary goal will help SBV to conduct better monetary policy. This can help to increase the credibility of the central bank and keep inflation expectation in control. A success in control inflation expectation can help to maintain inflation at a stable and appropriate level. Moreover, choosing price stability as a primary does not mean that SBV

must forego other objectives as presented in the study of Mai (2007). However, further details are beyond the scope of this study.

In conclusion, SBV should give the priority of monetary policy to price stability.

### **7.3.2. The independence of the central bank**

As discussed in section 2, SBV does not have a sufficient independence as a central bank to conduct monetary policy as the final decision belongs to the government and National Assembly. However, as mentioned in studies, the central bank should be given more independence to be able to conduct an effective monetary policy (Blanchard and Johnson, 2013). One argument for this independence is a central bank with high independence is more likely to avoid the mistake of trying to pursue high economic growth and sacrifice price stability, which can lead to a substantive increase in inflation and hurt the poorest class in the country (Mai, 2007).

### **7.3.3. Monetary transmission channels**

As the economic environment is becoming more dynamics, SBV should improve and use all the channels to transmit the effect of monetary policy. In order to achieve this effectiveness, SBV needs to improve some elements in each channel.

The interest rate channel:

- The full liberalization of the interest rate is of vital importance. As argued by Bhattacharya (2014), the liberalization of interest rate can help to keep the price level stable and mitigate the unfavorable impact of external shocks on the economy. Because when letting the market determines the interest rate, it is more likely that the existing interest rate is the most effective rate at which the quantities of money demand and supply equal. When there is a shock to the market, it is easy to reach the new equilibrium. In case the interest rate is regulated, it is more likely that the rate in the market is not at equilibrium, and when shocks hit the

market, it is much harder to reach the new equilibrium and this disequilibrium in the market can translate into negative impacts on macroeconomic variables.

- SBV also needs to erase the relationship between SOCBs and SOEs to prevent any violation of the market rate, and this can help to reduce bad debts as well as allow the interest rate channel to work effectively.

The credit channel:

- It is shown that the credit channel has become less important. Moreover, the complication of the environment after 2007 has led to the loss of control over money aggregate of SBV (Pham, 2016). Therefore, these suggest that SBV should not pay too much attention to this channel in conducting its monetary policy.

The exchange rate channel:

- For the current situation, a pegged exchange rate is appropriate. A fixed exchange regime will make the economy more vulnerable to foreign shocks, especially inflation in Vietnam after 2007 has already experienced a large influence from external shocks. However, adopting a floating regime is not a wise choice for a small economy like Vietnam (Hammond et al., 2009).
- SBV also needs to balance between the desirous exchange rate and foreign investment as implying by the Trilemma rule (Pham, 2016).

#### **7.3.4. Recommendations in the long term:**

- The government should attempt to promote the development of the financial system. As seen from the discussion above, financial system play an important role in designing and implementing an effective monetary policy. Some suggestions for financial liberalization in Vietnam are privatizing SOCBs,



promoting the development of JSCBs, improve the financial markets, encouraging the development of foreign exchange market.

- When conditions of the financial system and international capital market are sufficient, SBV can consider to undertake a floating exchange regime as well as try new monetary policy regime, namely inflation targeting.

## **8. CONCLUSION AND FUTURE RESEARCHES**

### **8.1. Main findings**

This study attempts to find the answer to these questions:

- 1) How do macroeconomic variables affect output and inflation in Vietnam?

In 1998-2006, increases in world oil price and Federal Fund Rate seemed to have positive impacts on output while the impact of rice price fluctuated. Moreover, output was likely to be most responsive to shocks from policy rate.

In 2007-2016, increases in world rice price and Federal Fund Rate seemed to have negative impacts on output, but the world oil price exerted fluctuated impact on output. The responses of output to exchange rate's shocks is the largest.

In 1998-2006, increases in world oil price and world rice price might lead to an increase in price level, but increases in Federal Fund Rate lead to a slightly decrease. Price level seemed to not responsive to shocks from monetary policy

In 2006-2016, increases in world oil price and world rice price led to an increase in price level, but the responses of CPI to an increase in Federal Fund Rate was negative and then positive. Furthermore, price level increased in response to an increase in money supply, and domestic credit aggregate. It also tended to increase in response to a devaluation of VND. Finally, it is possible that an increase in interest rate lead to a decrease in inflation despites a small increase in the first period.

- 2) How significantly do domestic and foreign variables affect output and inflation in Vietnam?

The effects of domestic and foreign variables on output are insignificant in both periods. However, the impacts on inflation of world rice price in 1998-2006, and of world oil price, world rice price and Federal Rate Fund in 2007-2016 is significant. For domestic variables, the effects of money supply, domestic credit aggregate, and exchange rate are all significant in 2007-2016.

- 3) What are the main drivers of output growth and inflation in the short-term?

The main drivers of output growth in 1998-2006 are itself and world oil price, but for 1998-2006, the main driver of output is only itself.

The main drivers of inflation in 1998-2006 are itself and external factors, namely world oil price, world rice price and Federal Fund Rate. However, the main drivers of inflation from 2007 to 2016 are itself, world oil price and domestic credit aggregate. Moreover, the total contributions of both foreign shocks and shocks from monetary policy are around 30%.

#### 4) What are the implications for monetary policy in Vietnam?

These are some recommendation for monetary policy in Vietnam:

- The goal of monetary policy: the priority of monetary policy should be given to price stability
- The independence of the central bank: more independence should be given to SBV in designing and conducting monetary policy.
- Monetary transmission channels:
  - o Liberalization of interest rate
  - o Less attention to the credit channel
  - o Pegged exchange rate with more flexibility
  - o Balancing between exchange rate and foreign investment
- Long-term recommendation:
  - o Developing the financial system and international capital market (government)
  - o Moving to inflation targeting and floating exchange rate regime

Finally, as the effects of external factors on Vietnamese economy are larger after 2007, it is recommended that SBV pays attention to movements of these variables and adjust the policy suitably.

## **8.2. Suggestions for Further Research**

Due to some limitations in methodology and the availability of data, this study is still incomplete. Future researches on this topic can focus on examining the long-term relationships of variables using approaches like VECM. Moreover, the study only focuses on a small set of variables, and it is likely that some important variables are omitted.

Therefore, more variables should be evaluated and added to the model so that the relationships and effects of monetary transmission mechanisms on domestic variables can be fully explained.

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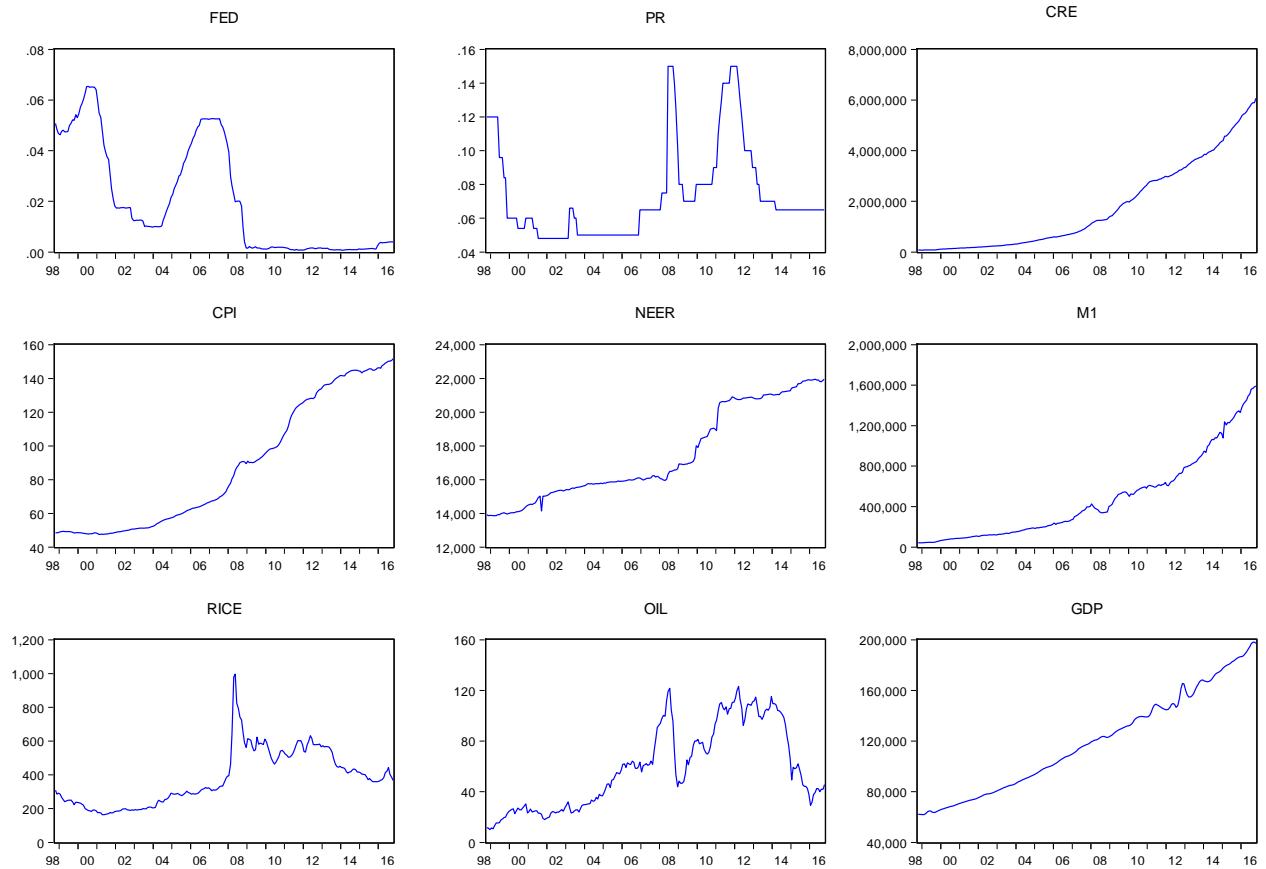
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## APPENDICES

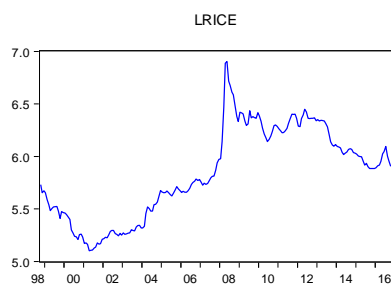
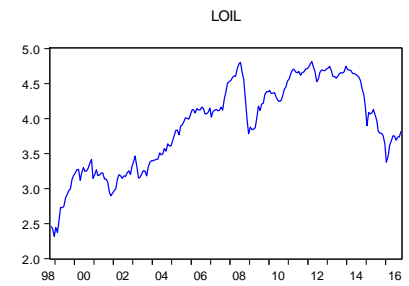
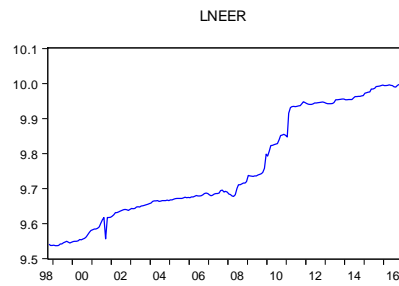
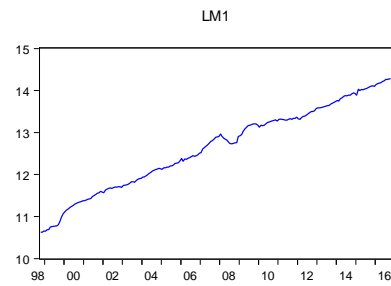
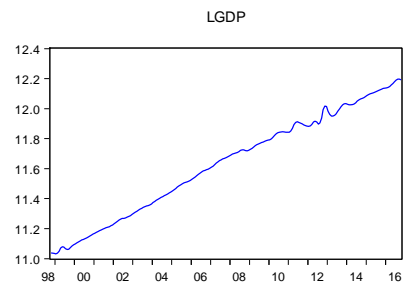
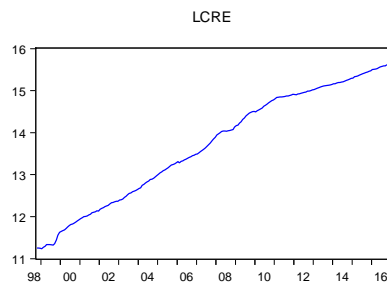
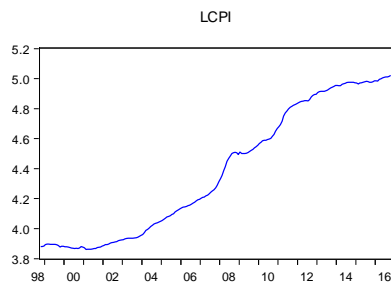
### Appendix A: Variable's graphs and residual plots of VAR (2)

#### Variable's graphs

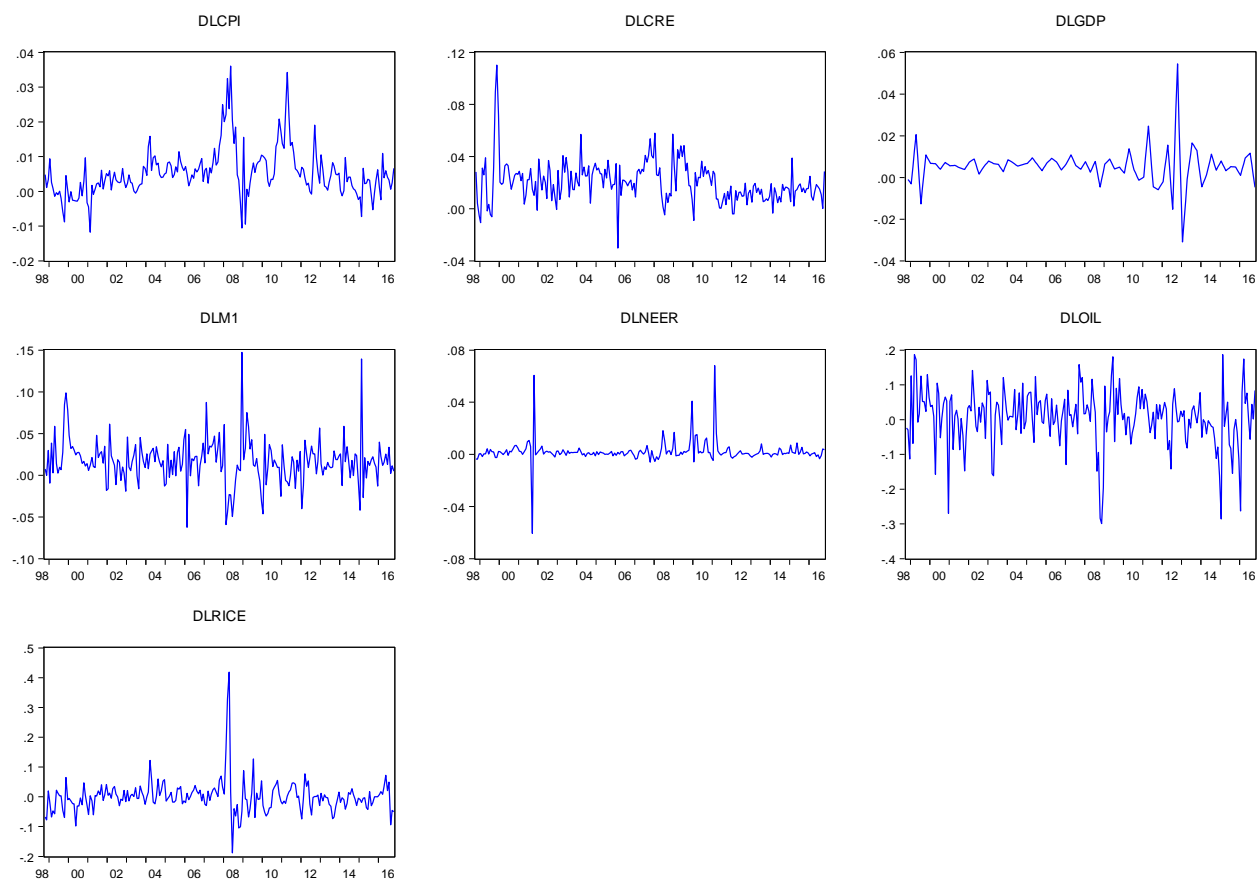
*In raw forms*



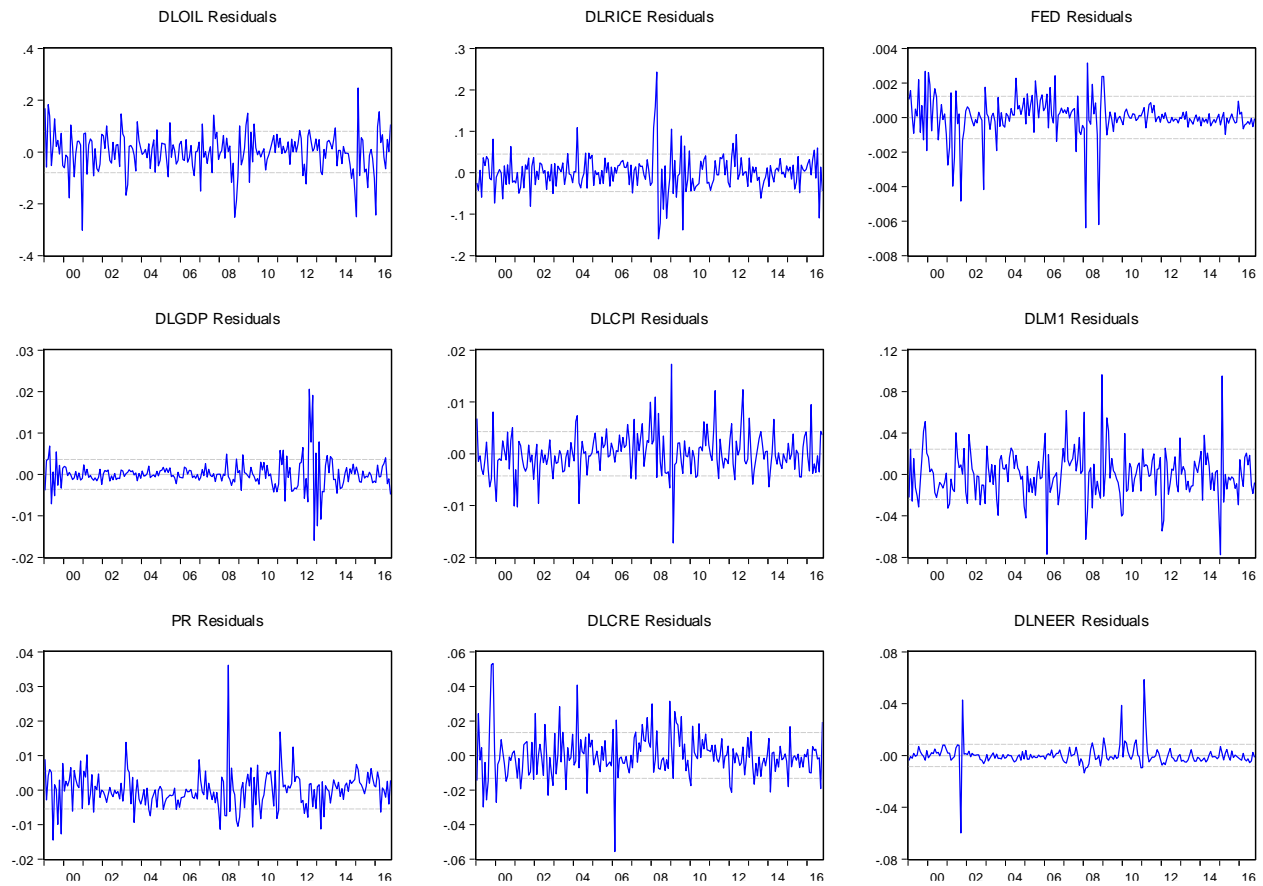
*In logarithm forms (not included FED and PR)*



*In first difference and logarithm forms (not included FED and PR)*



## Residual plots



## Appendix B: Summary of tests to set up model identification

### Interest rate channel

1998-2006

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 04/07/17 Time: 19:37

Sample: 1998M11 2006M12

Included observations: 92

Dependent variable: POLICY\_RATE

Excluded	Chi-sq	df	Prob.
DLCPI	2.491404	6	0.8694
DLGDP	25.27968	6	0.0003
DLM1	1.193593	6	0.9772
All	31.21654	18	0.0272

Dependent variable: DLCPI

Excluded	Chi-sq	df	Prob.
POLICY_RATE	19.67088	6	0.0032
DLGDP	9.212955	6	0.1620
DLM1	4.531789	6	0.6051
All	29.64316	18	0.0411

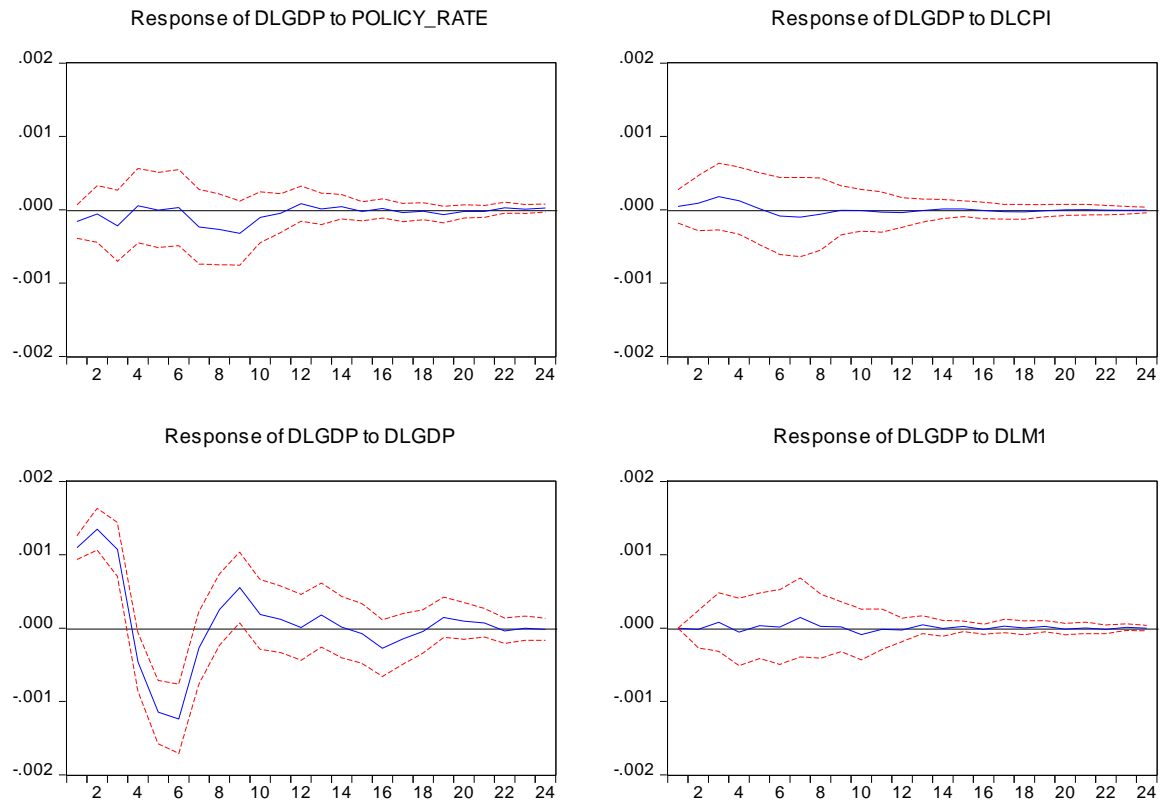
Dependent variable: DLGDP

Excluded	Chi-sq	df	Prob.
POLICY_RATE	50.74187	6	0.0000
DLCPI	3.008861	6	0.8077
DLM1	4.488385	6	0.6109
All	68.66386	18	0.0000

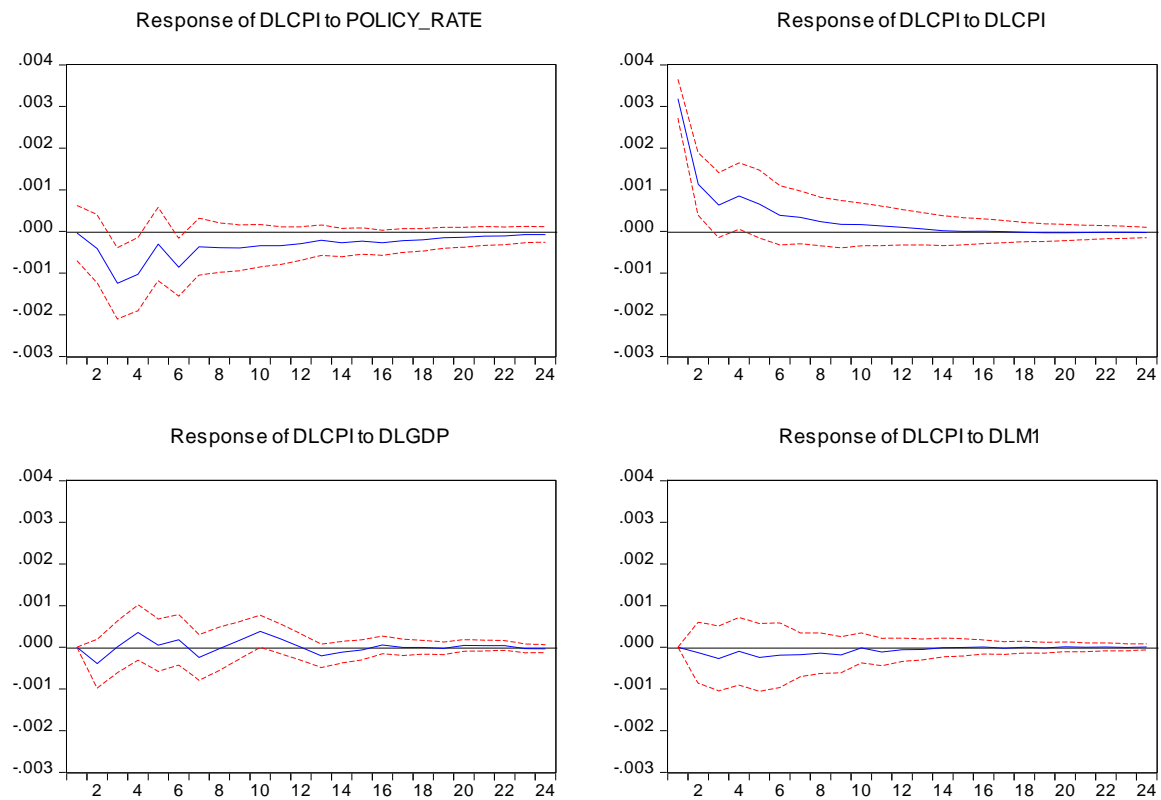
Dependent variable: DLM1

Excluded	Chi-sq	df	Prob.
POLICY_RATE	13.00332	6	0.0430
DLCPI	2.230614	6	0.8973
DLGDP	9.179306	6	0.1637
All	34.36502	18	0.0113

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.





## 2007-2016

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 04/07/17 Time: 19:34

Sample: 2007M01 2016M10

Included observations: 118

Dependent variable: DLCPI

Excluded	Chi-sq	df	Prob.
DLGDP	7.943965	6	0.2422
DLM1	15.47820	6	0.0168
POLICY_RATE	4.881811	6	0.5591
All	31.41498	18	0.0258

Dependent variable: DLGDP

Excluded	Chi-sq	df	Prob.
DLCPI	3.220231	6	0.7807
DLM1	1.885677	6	0.9299
POLICY_RATE	5.094275	6	0.5318
All	12.49407	18	0.8207

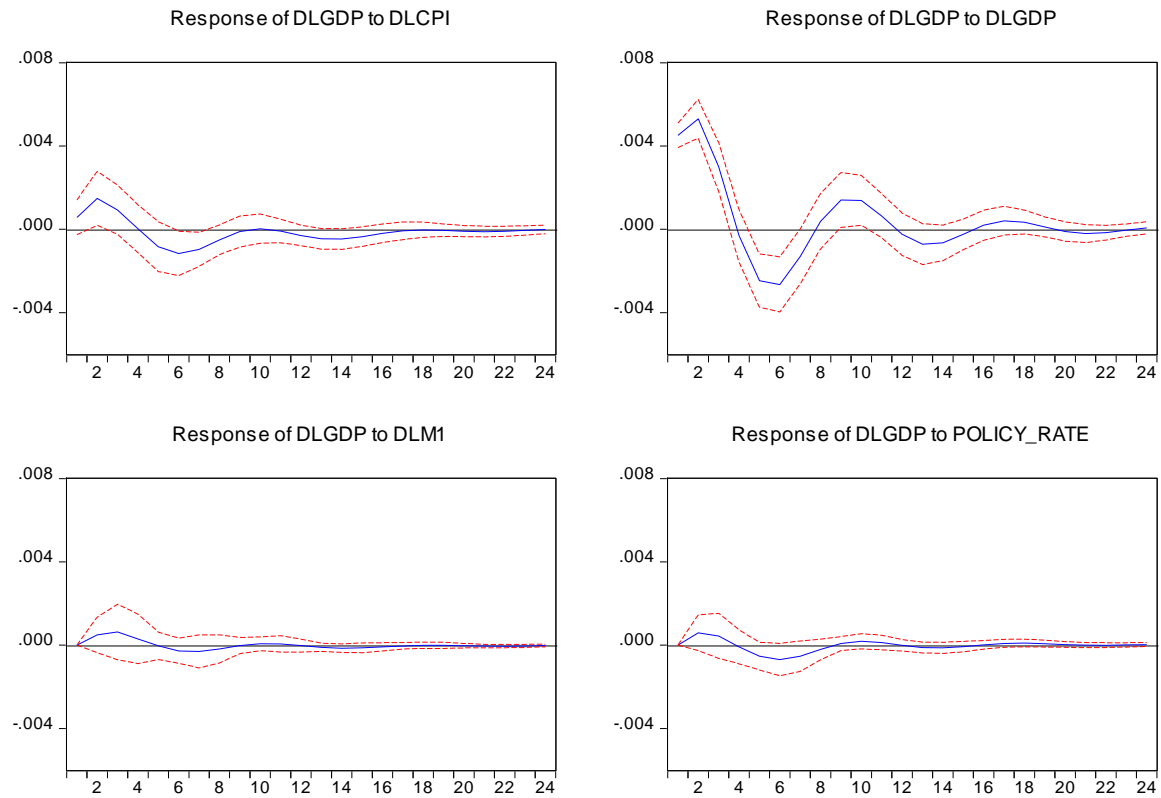
Dependent variable: DLM1

Excluded	Chi-sq	df	Prob.
DLCPI	13.88869	6	0.0309
DLGDP	2.667235	6	0.8493
POLICY_RATE	5.936071	6	0.4304
All	25.16891	18	0.1203

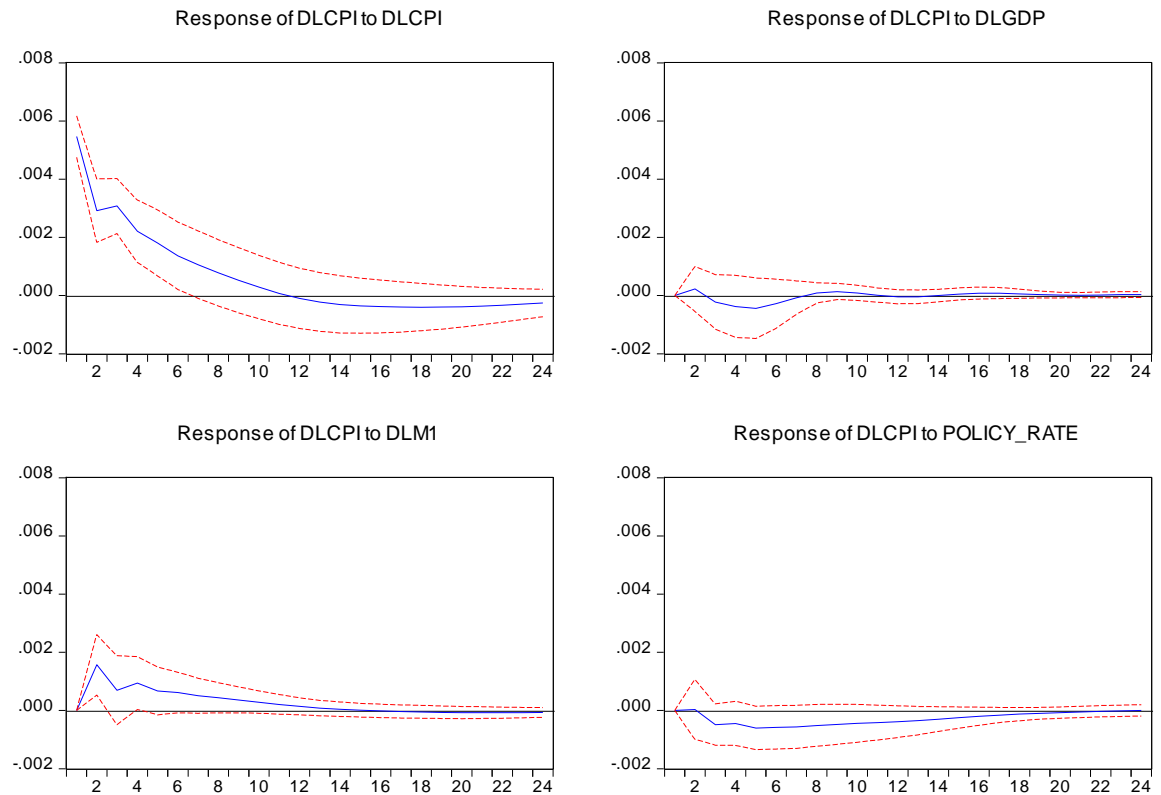
Dependent variable: POLICY\_RATE

Excluded	Chi-sq	df	Prob.
DLCPI	36.50453	6	0.0000
DLGDP	2.240258	6	0.8963
DLM1	13.21310	6	0.0398
All	57.58312	18	0.0000

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



## **Credit channel**

1998-2006

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 03/17/17 Time: 23:29

Sample: 1998M11 2006M12

Included observations: 92

Dependent variable: DLCPI

Excluded	Chi-sq	df	Prob.
DLCRE	1.237986	6	0.9750
DLGDP	5.045733	6	0.5380
DLM1	2.452602	6	0.8737
All	9.089391	18	0.9576

Dependent variable: DLCRE

Excluded	Chi-sq	df	Prob.
DLCPI	5.825143	6	0.4431
DLGDP	21.55273	6	0.0015
DLM1	10.60037	6	0.1015
All	40.13811	18	0.0020

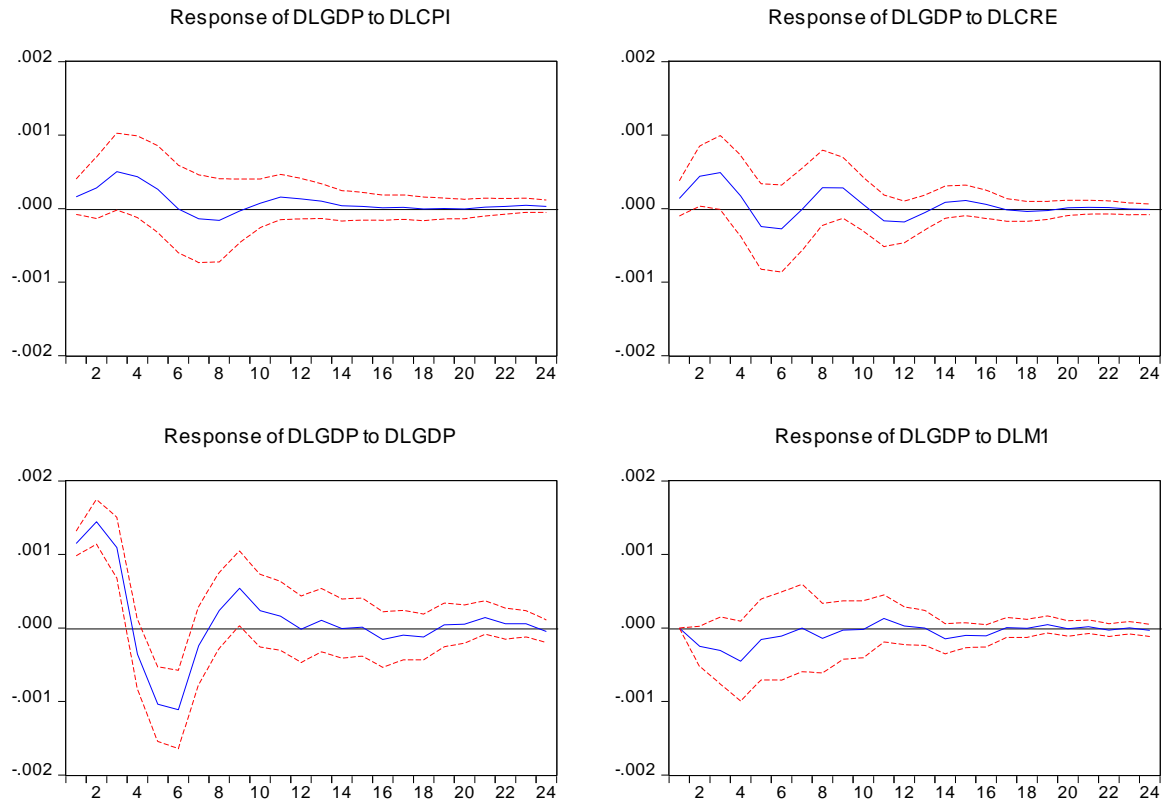
Dependent variable: DLGDP

Excluded	Chi-sq	df	Prob.
DLCPI	7.821588	6	0.2515
DLCRE	13.13343	6	0.0410
DLM1	8.960079	6	0.1758
All	25.33087	18	0.1161

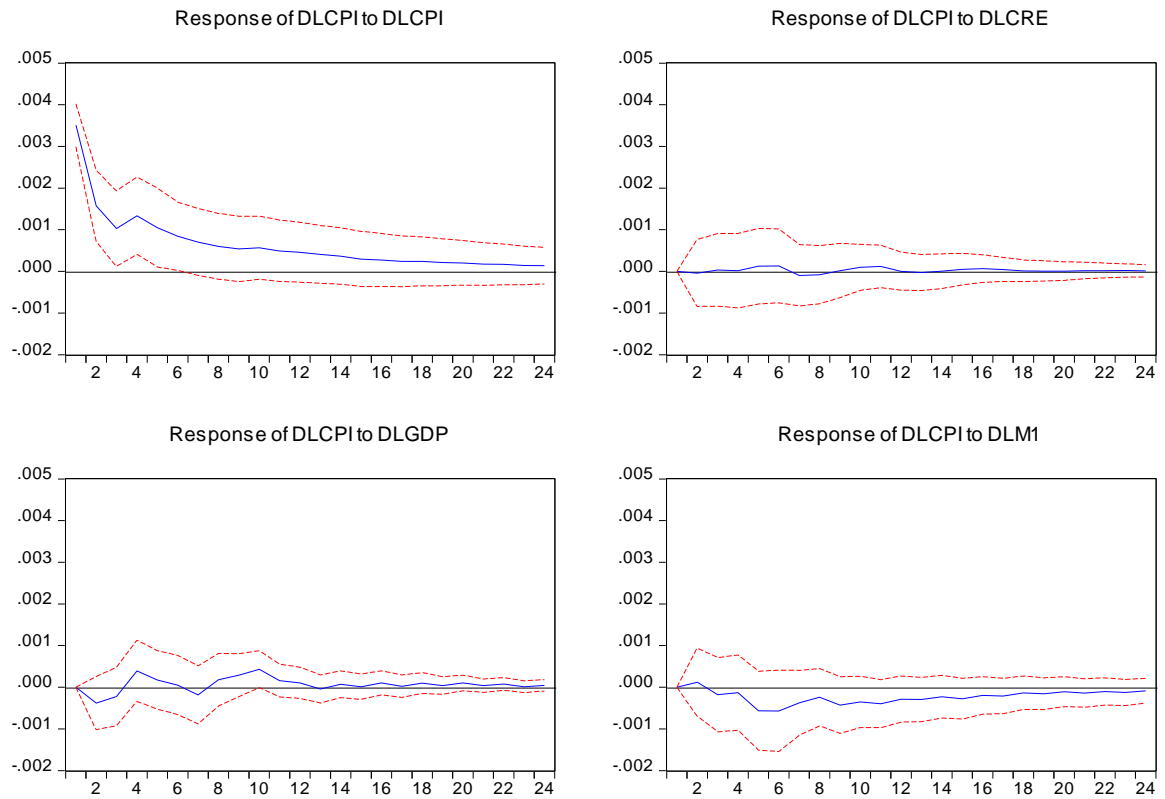
Dependent variable: DLM1

Excluded	Chi-sq	df	Prob.
DLCPI	3.436502	6	0.7524
DLCRE	5.133601	6	0.5268
DLGDP	7.977999	6	0.2397
All	24.39401	18	0.1425

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



## 2007-2016

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 03/18/17 Time: 11:57

Sample: 2007M01 2016M10

Included observations: 118

Dependent variable: DLCPI

Excluded	Chi-sq	df	Prob.
DLCRE	14.35472	6	0.0259
DLGDP	7.976527	6	0.2398
DLM1	7.975095	6	0.2399
All	43.45575	18	0.0007

Dependent variable: DLCRE

Excluded	Chi-sq	df	Prob.
DLCPI	8.271294	6	0.2189
DLGDP	2.405316	6	0.8789
DLM1	16.33095	6	0.0121
All	26.78910	18	0.0830

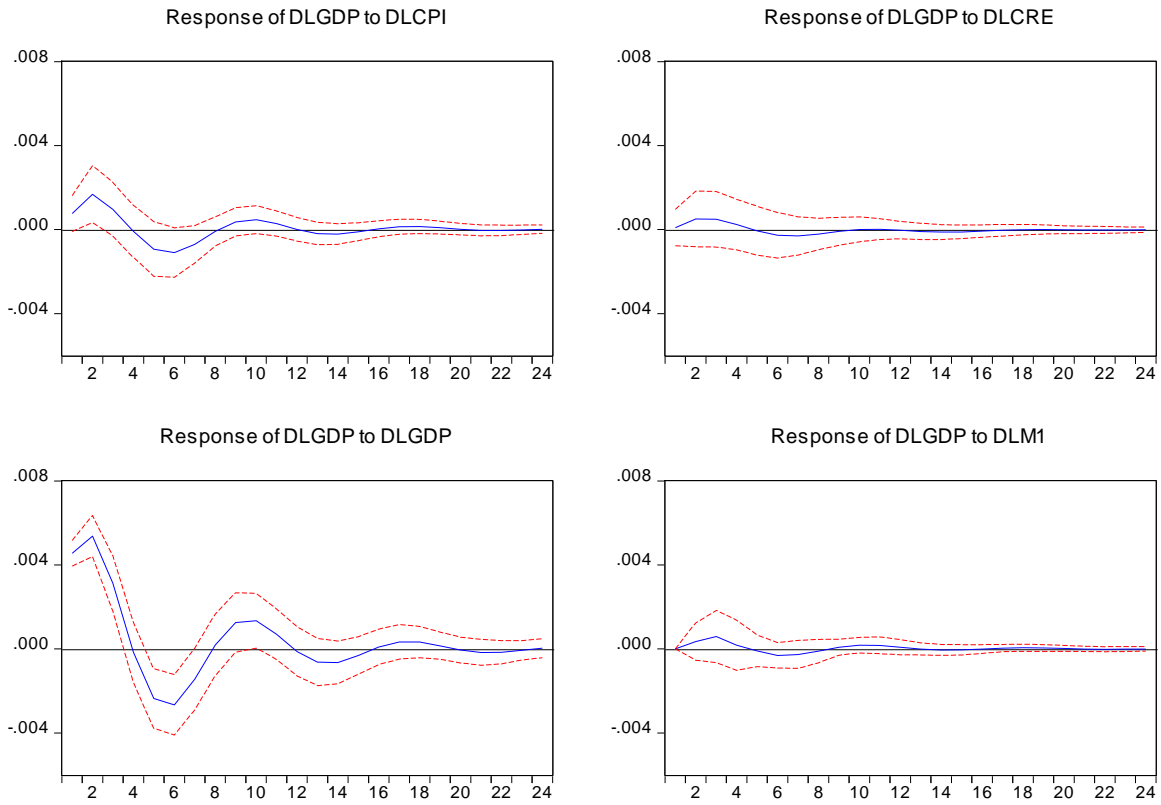
Dependent variable: DLGDP

Excluded	Chi-sq	df	Prob.
DLCPI	1.834165	6	0.9343
DLCRE	3.087624	6	0.7978
DLM1	3.770308	6	0.7077
All	10.33604	18	0.9204

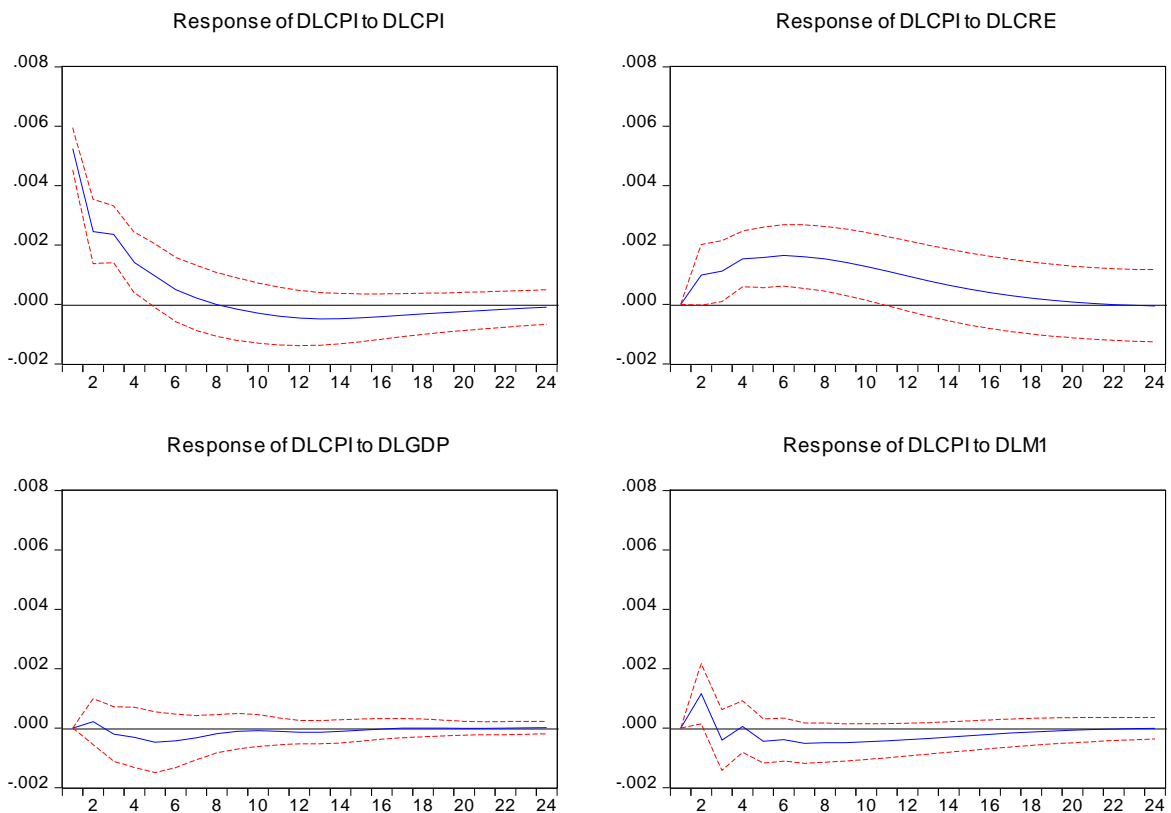
Dependent variable: DLM1

Excluded	Chi-sq	df	Prob.
DLCPI	8.527376	6	0.2020
DLCRE	2.632708	6	0.8533
DLGDP	2.137136	6	0.9067
All	21.22338	18	0.2683

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



## **Exchange rate channel**

1998-2006

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 03/17/17 Time: 23:40

Sample: 1998M11 2006M12

Included observations: 92

Dependent variable: DEXIM

Excluded	Chi-sq	df	Prob.
DLCPI	9.996847	6	0.1248
DLGDP	2.840550	6	0.8286
DLM1	5.319612	6	0.5035
DLNEER	1.393869	6	0.9662
All	19.44958	24	0.7276

Dependent variable: DLCPI

Excluded	Chi-sq	df	Prob.
DEXIM	6.351385	6	0.3850
DLGDP	4.827372	6	0.5661
DLM1	3.166184	6	0.7877
DLNEER	7.697868	6	0.2611
All	20.06351	24	0.6932

Dependent variable: DLGDP

Excluded	Chi-sq	df	Prob.
DEXIM	13.53296	6	0.0353
DLCPI	7.510664	6	0.2762
DLM1	5.419474	6	0.4912
DLNEER	3.620610	6	0.7279
All	28.59607	24	0.2357

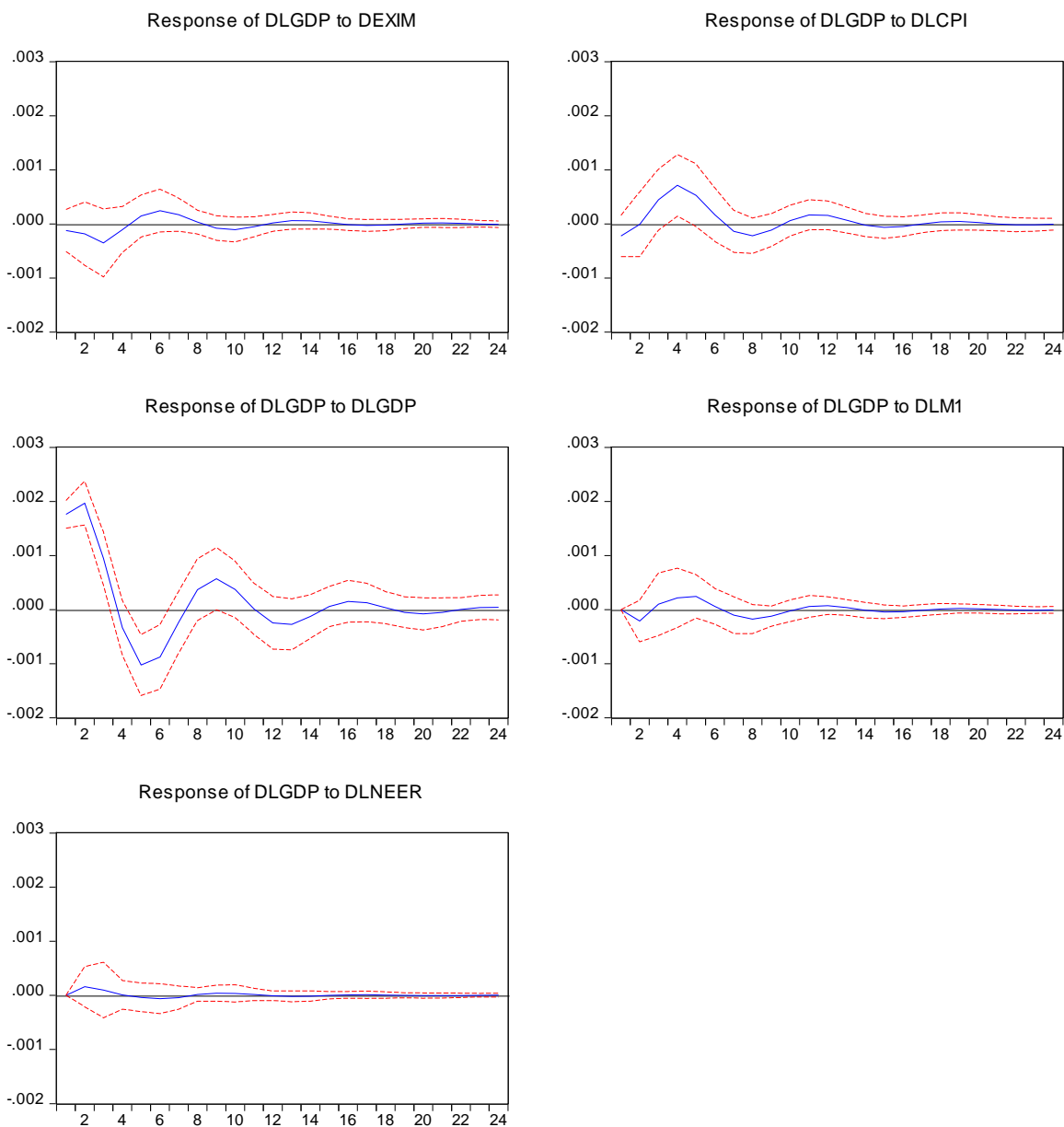
Dependent variable: DLM1

Excluded	Chi-sq	df	Prob.
DEXIM	8.471030	6	0.2056
DLCPI	2.862515	6	0.8259
DLGDP	12.85371	6	0.0454
DLNEER	9.874659	6	0.1300
All	37.38954	24	0.0400

Dependent variable: DLNEER

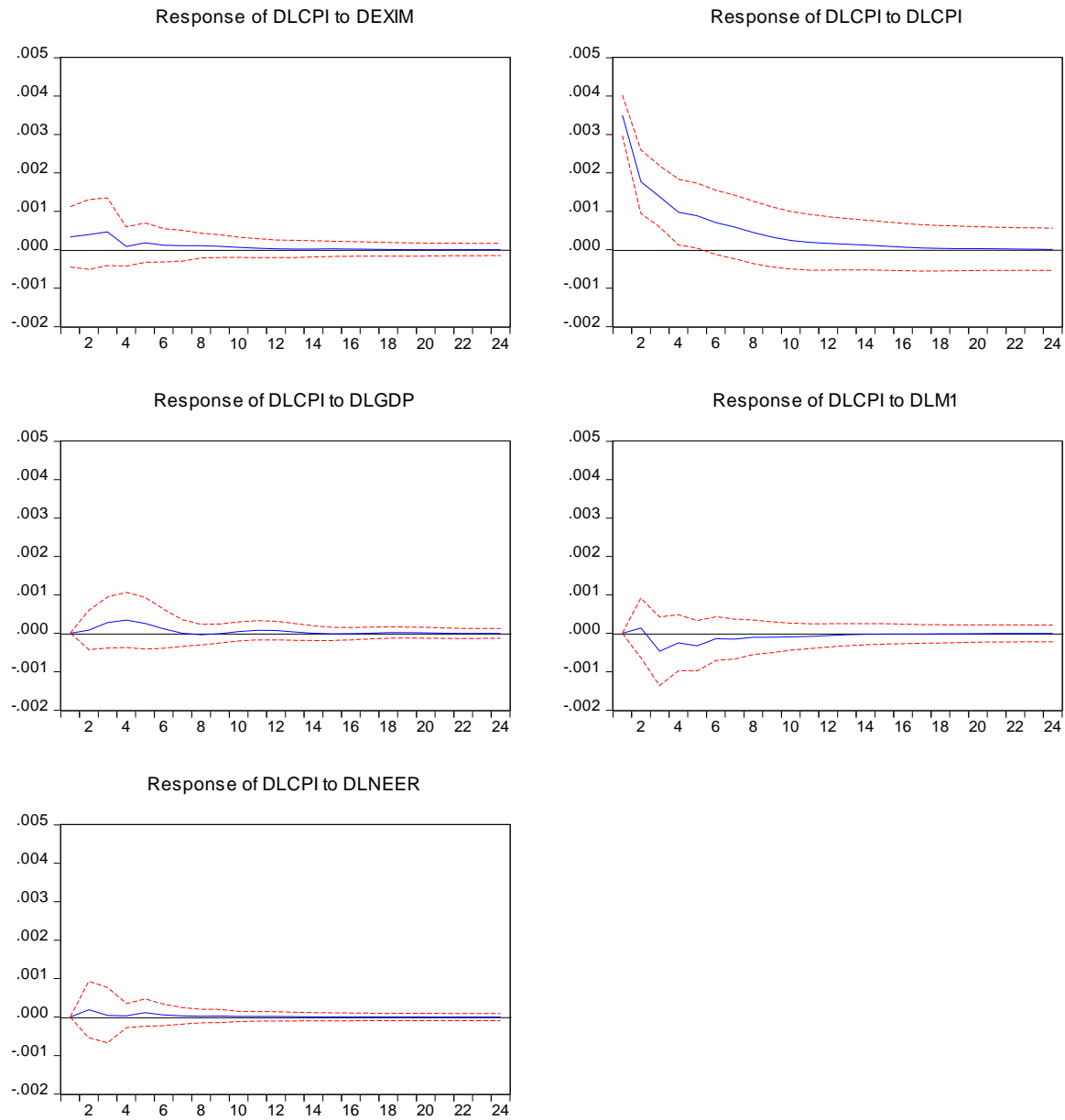
Excluded	Chi-sq	df	Prob.
DEXIM	6.688158	6	0.3507
DLCPI	12.04534	6	0.0610
DLGDP	3.327088	6	0.7668
DLM1	9.700976	6	0.1378
All	27.75829	24	0.2704

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.





Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



## 2007-2016

### VAR Granger Causality/Block Exogeneity Wald Tests

Date: 03/18/17 Time: 12:07

Sample: 2007M01 2016M10

Included observations: 118

#### Dependent variable: DEXIM

Excluded	Chi-sq	df	Prob.
DLCPI	5.589386	6	0.4707
DLGDP	3.812614	6	0.7020
DLM1	23.76239	6	0.0006
DLNEER	17.76295	6	0.0069
All	74.17951	24	0.0000

#### Dependent variable: DLCPI

Excluded	Chi-sq	df	Prob.
DEXIM	10.51813	6	0.1045
DLGDP	11.68341	6	0.0694
DLM1	13.18838	6	0.0401
DLNEER	17.56408	6	0.0074
All	58.81262	24	0.0001

#### Dependent variable: DLGDP

Excluded	Chi-sq	df	Prob.
DEXIM	1.499579	6	0.9595
DLCPI	3.065884	6	0.8005
DLM1	2.511392	6	0.8672
DLNEER	3.658455	6	0.7228
All	11.96213	24	0.9803

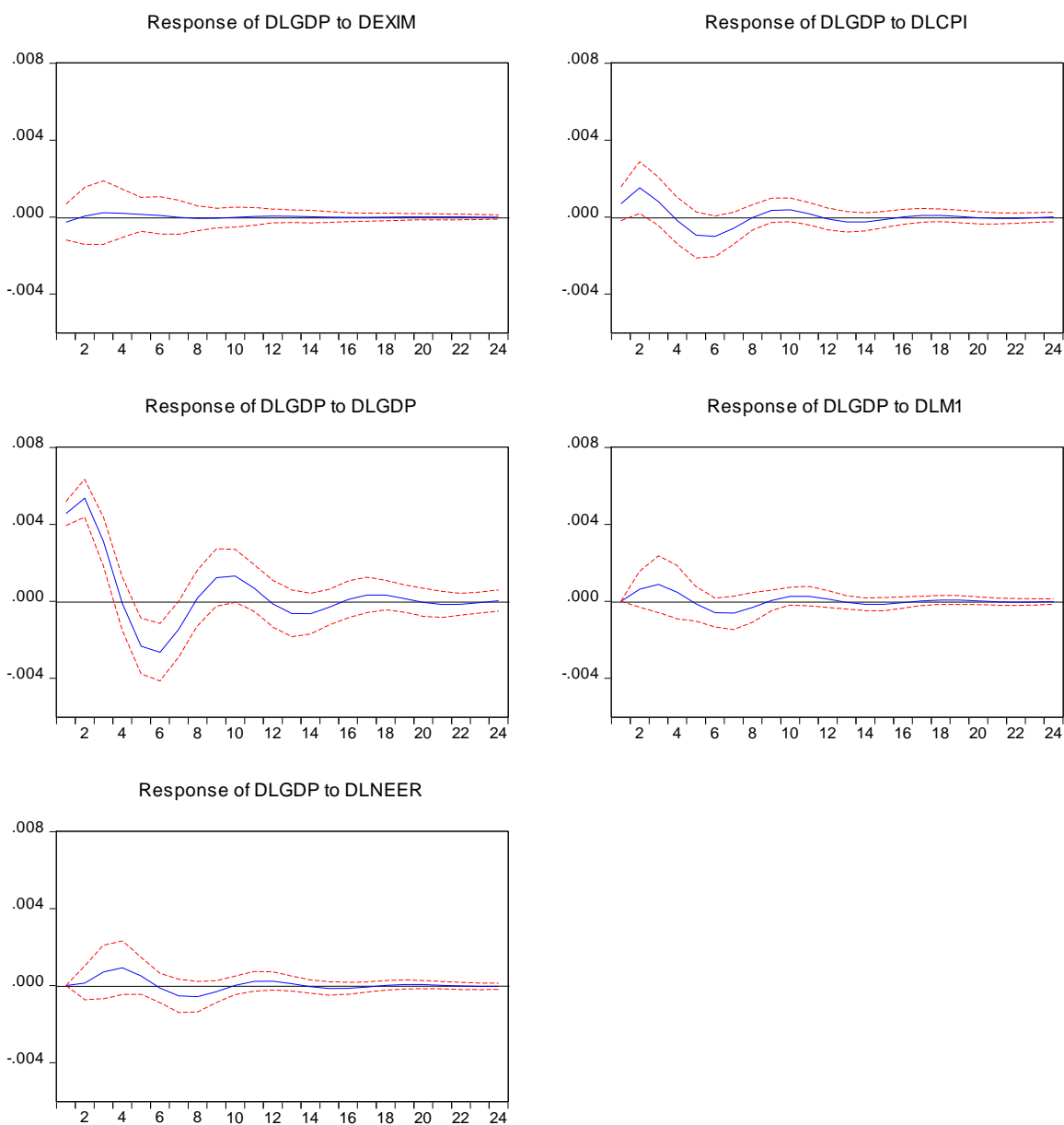
#### Dependent variable: DLM1

Excluded	Chi-sq	df	Prob.
DEXIM	3.534434	6	0.7394
DLCPI	12.96890	6	0.0435
DLGDP	2.633791	6	0.8532
DLNEER	5.229513	6	0.5147
All	30.44381	24	0.1705

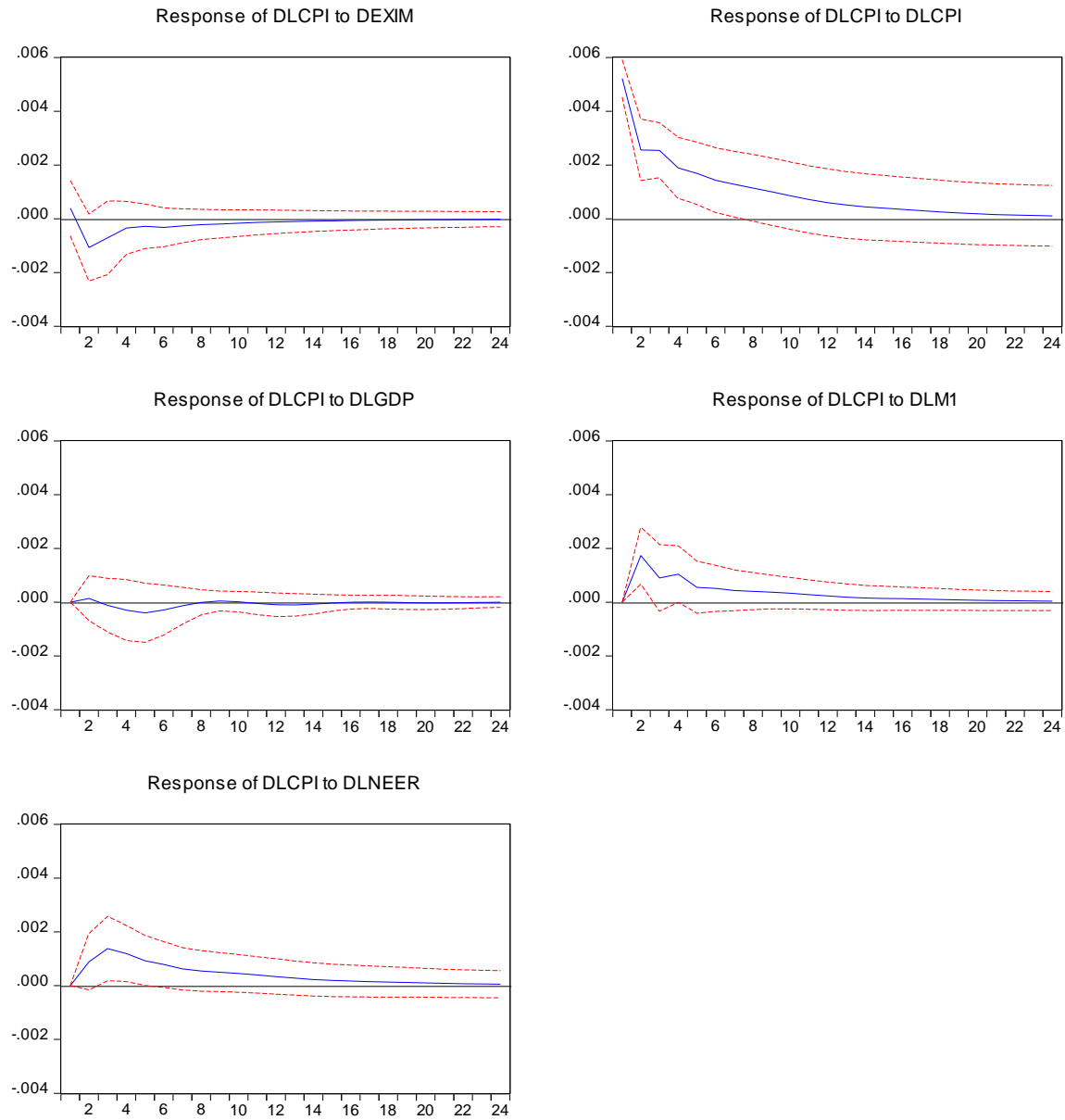
Dependent variable: DLNEER

Excluded	Chi-sq	df	Prob.
DEXIM	3.569375	6	0.7347
DLCPI	1.603945	6	0.9523
DLGDP	2.000791	6	0.9196
DLM1	7.607126	6	0.2683
All	15.94802	24	0.8899

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

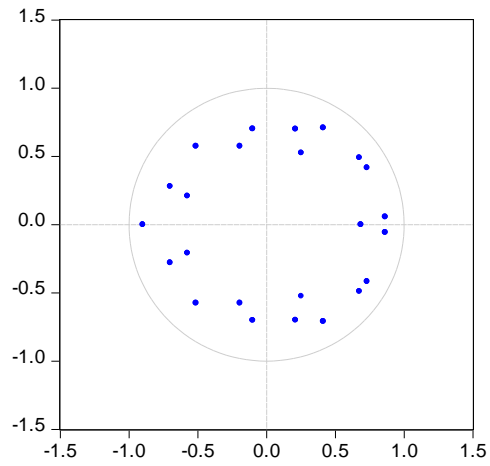


Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

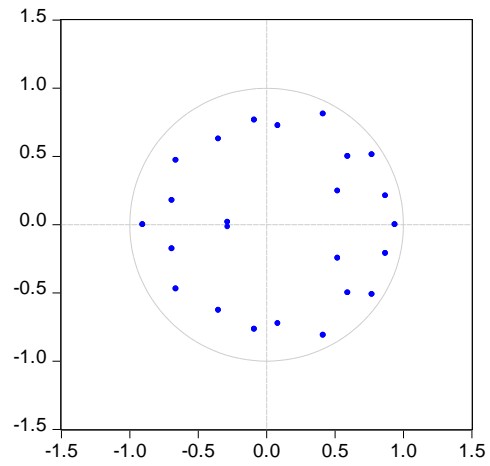


## Reports of VAR Stability

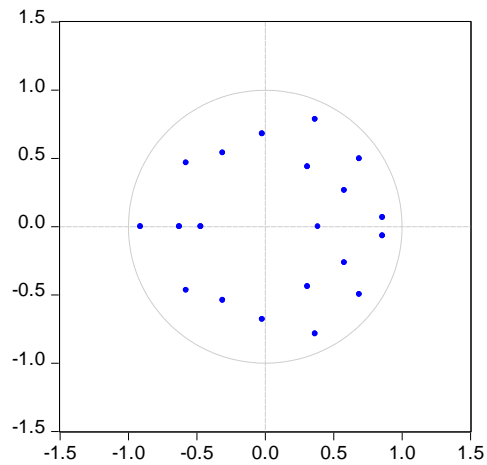
Inverse Roots of AR Characteristic Polynomial  
1998-2006, VAR(6), Interest Rate Channel



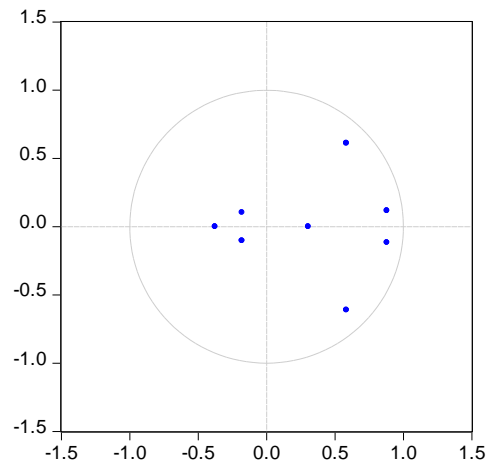
Inverse Roots of AR Characteristic Polynomial  
2006-2007, VAR(6), Interest rate channel



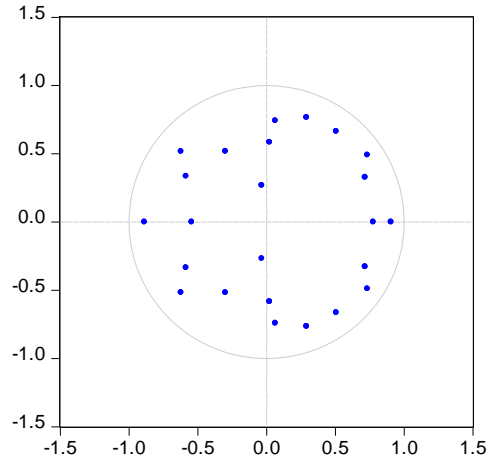
Inverse Roots of AR Characteristic Polynomial  
1998-2006, VAR(5), Interest Rate Channel



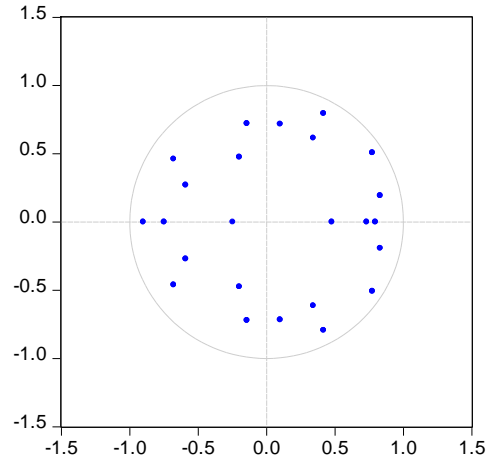
Inverse Roots of AR Characteristic Polynomial  
2007-2016, VAR(2), Interest Rate Channel



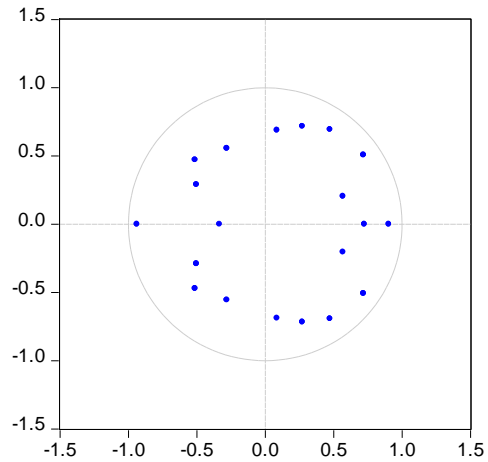
Inverse Roots of AR Characteristic Polynomial  
1998-2006, VAR(6), Credit Channel



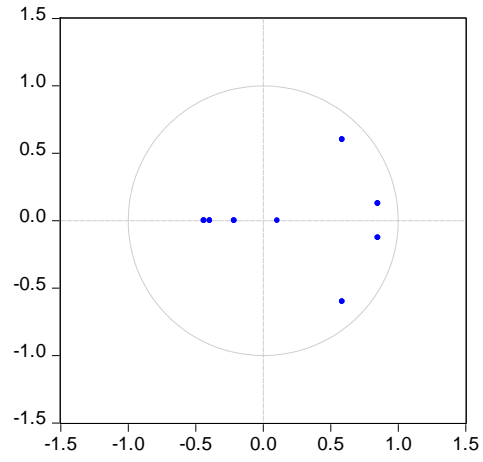
Inverse Roots of AR Characteristic Polynomial  
2007-2016, VAR(6), Credit Channel



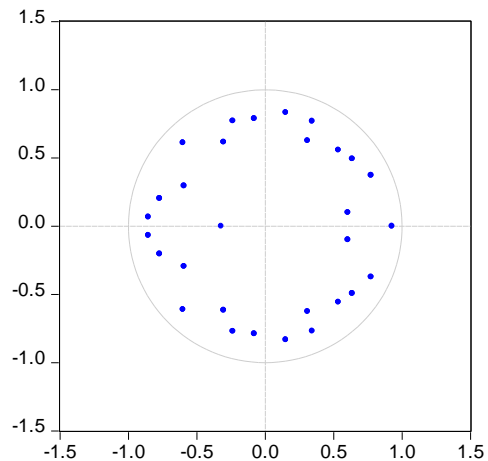
Inverse Roots of AR Characteristic Polynomial  
1998-2006, VAR(5), Credit Channel



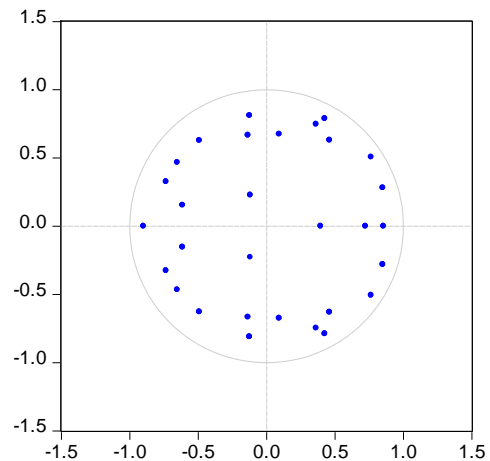
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2007-2016, VAR(2), Credit Channel

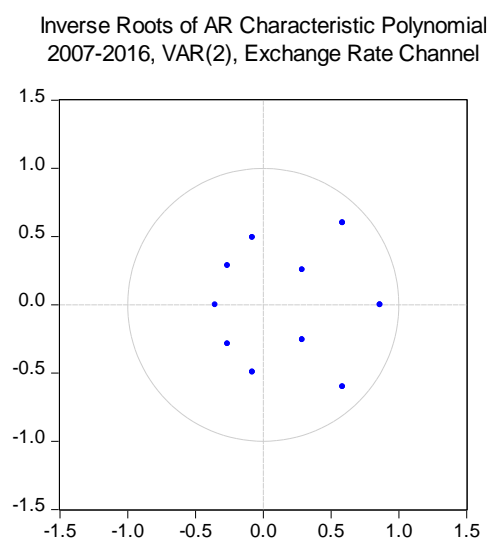
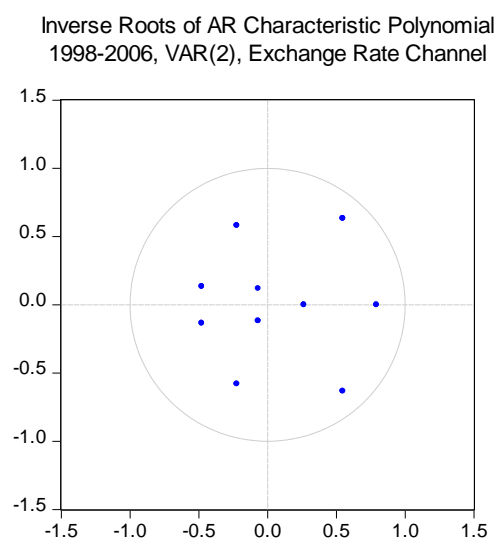


Inverse Roots of AR Characteristic Polynomial  
1998-2006, VAR(6), Exchange Rate Channel



Inverse Roots of AR Characteristic Polynomial  
2007-2016, VAR(6), Exchange Rate Channel





All the VAR models used to set up the identification satisfy the stability condition.

### **Unit root tests of EXIM**

	Level		First difference	
	AIC	p-value	AIC	p-value
Intercept and trend	-3.097564	0.0282	-7.286633	0.0000
Intercept	-3.273954	0.0734	-7.305860	0.0000
None	0.001069	0.6819	-7.286175	0.0000

Based on results of unit root tests of EXIM, this study takes the first difference of this variable before estimating the VAR models to guarantee the stationary requirements for data.